The Welding Engineer

Reg. U. S. Pat. Office

Founded by L. B. Mackenzie, 1916

JUNE, 1927 VOL. 12, No. 6

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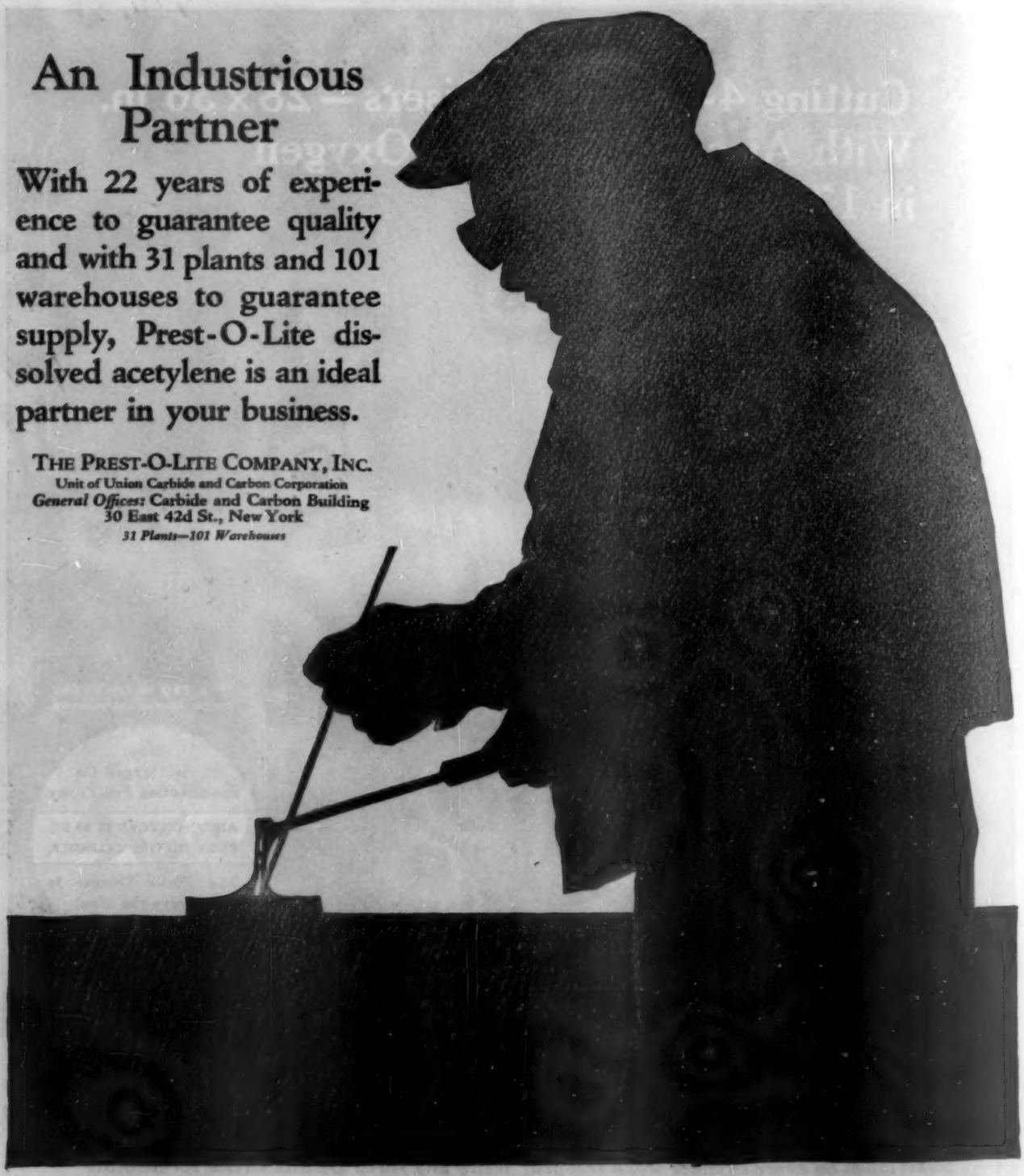

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The Welding Engineer

Founded by L. B. Mackenzie, 1916

Volume 12 | June, 1927 | Number 6

CONTENTS

All Welded Refrigeration System 31
Welding a Gas Purifier 34
By R. K. Randall
Shop Tools Made to Order 37
By Will Stewart
Making Gears by Arc Welding 39
Welded Kitchens in the New Stevens 44
Editorial 29
Tells Reasons for Mokelumne Failures 33
200-Mile Oil Pipe Line 33
Gas Welding Versus Flange Joints 38
Cutting Heavy Steel Risers 42
Presentation of Morehead Medals 42
Gas Welded House Heating Systems 43
Welding a Steel Structure 47
Microscope Shows Character of Spot Weld 48
New Cleveland Welding School 49
Welding Bridge Caissons 49
Spot Welding on Furniture 50
Apartment Hotel Uses Welding in New Construction 50
Fender Welding with Bronze 51

Progress in Buying

A BUNDLE of welding wire is more than just so many pounds of steel, and a welding torch is more than so many ounces of brass. The progressive buyer will look behind the scenes to get facts he needs for buying to the best advantage. He will look behind the welder to see what service is wanted from equipment and materials, and what factors have the most influence on ultimate cost. He will look behind the catalog, too, and discover what is being offered to him that isn't in the picture. New products and new improvements mean a lot to the man who uses this sort of care in making purchases. He is on the lookout for ideas that will help him buy to the best advantage. Business paper advertising gives him a chance to study and compare entire groups with the least inconvenience, and with the assurance of getting acquainted with the most progressive makers of the things he wants.

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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Commercial Acetylene Supply Co.
International Oxygen Co.
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See "Torches."

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Wodack Electric Tool Corp.

BUTT WELDERS
See "Electric Resistance Welders"

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See "Cutting Electrodes"

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R. D. Thomas Co.
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Seneca Electric Arc Welder Co.
Strauss & Buegeleisen
R. D. Thomas Co.
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Wilson Welder & Metals Co.
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Page Steel & Wire Co.
Reid-Avery Co.
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Steel Sales Corp.
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Stulz-Sickles Co.
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Torchweld Equipment Co.
Weldene Corporation
Weldit Acetylene Co.

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National Gauge & Equipment Co.

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Modern Engineering Co.
Oxweld Acetylene Co.
U. S. Welding Co.

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Strauss & Buegeleisen
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GRAPHITE (Rods, Blocks, Paste, Etc.)
Joseph Dixon Crucible Co.

Ohio Bell Telephone Bldg., Cleveland, Ohio

Left: Operator at work on one of the 16-inch steam risers. *Center:* Main riser with five manifolds, showing 8-inch welded connections. *Below:* 16-inch flange, welded on both sides of expansion joint.

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BEFORE Smith & Oby, Cleveland plumbing and heating contractors and engineers, started to weld the steam risers that feed fifteen stories of the Ohio Bell Telephone Building, they made test after test in the laboratory to find the welding wire they could depend upon to *hold*. Pieces of 8" pipe were butt-welded, test coupons were cut, and then pulled and bent—the coupons were all machined flush, and welded with the same machine and by the same operator. *In these tests the welds made with Wilson "Color-tipt" Welding Wire were the only ones that broke outside the weld.*

Trade Mark Reg. U.S.Pat.Off.

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C. H. Hollup Corp.
Ideal Face Shield Co.
Lincoln Electric Co.
Mattice Engineering Co.
Northwestern Mfg. Co.
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Seneca Electric Arc Welder Co.
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Milburn, Alexander, Co.
Modern Engineering Co.
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Torchweld Equipment Co.
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See "Electric Resistance Welders"

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Milburn, Alexander, Co.
Modern Engineering Co.
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Torchweld Equipment Co.
U. S. Welding Co.
Welding Service Co.
Weldit Acetylene Co.
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Joseph Dixon Crucible Co.
Modern Engineering Co.
National Carbon Co.

WELDING ROD HOLDERS
C. Sorensen

WELDING RODS AND WIRE
See "Electrodes" and "Filler Rods"

ALPHABETICAL INDEX TO ADVERTISERS

A

Air Reduction Sales Co. ... 3
Allan Mfg. and Welding Co. ... 63
American Brass Co., The ... 55
American Welding Society ... 56
Anti-Borax Compound Co. ... 70

B

Betts ... 70
Burdett Oxygen Co. ... 61
Burke Electric Co. ... 69

C

Carbic Mfg. Co. ... 62
Central Steel & Wire Co. ... 19
Chicago Steel & Wire Co. ... 62
Commercial Acetylene Supply Co. ... 64
Craftsweld Equipment Co. ... 67

D

Dixon Crucible Co., Joseph ... 66
Dunham, Keith, Co. ...

E

Elec. Arc Cutting & Welding Co. ..Back Cover
Electric Welding Machine Co. ...
Elkon Works, Inc. ...Inside Back Cover

F

Federal Machine & Welder Co. ... 58
Fibre Metal Products Co. ...

G

Gas Products Assn. ... 12
General Electric Co. ...13, 14, 15
Gibb Welding Machine Co. ... 68
Goodman Electric Mach. Co. ... 70

H

Harris Calorific ... 10
Heylandt Sales Co. ... 70
Hollup, C. H. ... 23
Hoxite Company ... 69

I

Ideal Face Shield Co. ... 69
Imperial Brass Mfg. Co. ... 64
International Oxygen Co. ... 68

K

Kerotest Mfg. Co. ... 27
K-G Welding Co. ... 61

L

Lincoln Electric Co. ... 16
Lincoln Steel Co. ...
Linde Air Products Co. ... 5
Lundy, E. A., Co. ... 28

M

Mattice Engineering Co. ... 67
Metal and Thermit Corp. ... 21
Milburn, Alexander, Co. ...Front Cover
Modern Engineering ... 22
Morey Flux & Chemical Co. ... 70
Moto Meter Co. ... 17

N

National Carbon Co. ...
National Gauge and Equipment Co. ... 17
National Carbide Co. ... 58
Northwestern Mfg. Co. ... 59
C. A. Norgren Co. ... 69

O

Owen Electric Mfg. Co. ... 18
Oxweld Acetylene Co. ... 30

P

Page Steel & Wire Co. ... 65
Pierce, R. C. ... 70
Pressed Steel Tank Co. ... 65
Prest-O-Lite Co., Inc., The ... 4

Q

Quasi-Arc Weltrode Co. ... 70

R

Reid-Avery Co. ... 11
Roebling, John A., Sons Co. ... 26

S

Seneca Electric Arc Welder Co. ... 66
Sorensen, C. ... 70
Shawinigan Products Corp. ... 67
Standard Steel & Wire Co. ... 57
Stevenson Distributing Corp. ... 68
Steel Sales Corp. ... 60
Strauss & Buegeleisen ... 70
Strand, N. A., & Co. ... 70
Stulz-Sickles Co. ... 66
Stoody Co. ... 63

T

Taylor-Hall Welding Co. ... 57
Thomas & Co., R. D. ...
Torchweld Equipment Co. ... 63

U

Una Welding & Bonding Co. ... 25
Union Carbide Sales Co. ... 9
U. S. Welding Co. ... 10

W

Vulcan Electric Brazing Co. ... 57
Waters Arc Welding Corporation ... 60
Weldene Corporation ...
Weldit Acetylene Co. ... 68
Welding Service Co. ... 67
Westinghouse Electric & Mfg. Co. ...
Wickwire, Spencer Co. ... 59
William Wharton, Jr. & Co., Inc. ...
Williams & Co., Inc. ... 66
Willson Goggles, Inc. ... 69
Wilson Welder & Metals Co. ... 7
Wodack Electric Tool Corporation ... 57

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With which is now merged the U. S. Welding Co., formerly of Minneapolis, Minn.

To the WELDING INDUSTRY

WE HONESTLY BELIEVE THAT

"RACO" WELDING RODS

ARE THE FINEST QUALITY RODS ON THE MARKET TODAY

WE manufacture bare electric welding rods of both Pure Iron and Mild Steel analysis. We do not recommend bare rods for electric welding. We believe that the manufacture of a good electrode only starts with a bare wire. However, as large quantities of bare electrodes are used throughout the country, we supply them to those who desire this class of material.

We believe our oxy-acetylene welding rods are the most perfect rods of this type on the American market. They are manufactured from steel and iron made expressly for the purpose. These wires are drawn and copper coated under the direct supervision of our Wire Drawing Superintendent, who has been drawing this type of wire for twenty-five years in France, Italy and Switzerland. The extremely high quality of material used and finish make it a pleasure to use "RACO" gas welding rods.

For electric welding we recommend Raco Composite Electrodes. These rods are used equally well with either A. C. or D. C. current. This rod was originally developed for automatic welding where bare wire will not function due to great speed in welding and high amperage used. The Composite Rod is recommended for all work where bare and covered electrodes have previously been used. Greatly increased speed and far better penetration is secured and absolute uniformity of rods throughout an order is absolutely guaranteed. A special flux of truly wonderful characteristics is inlaid in the lengthwise grooves the entire length of the wire. The flux is protected in the grooves and cannot chip out, even when the wire is bent flat against itself. The accurate depth of the grooves automatically regulates the correct amount of flux needed.

The Composite Wire is furnished on reels for automatic arc welding and will give perfect results under special conditions of high speed and high amperage. The flux in the grooves contains a high percentage of titanium and will weld Cast Iron with better results than any electrode on the market today.

Our Company specializes in drawing welding wire only. We have no other interests and can give our welding rods our undivided attention.

Raco Welding Rods are fairly priced and we are able to give real service from our new plant at Dundalk, Maryland.

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THAT oxy-acetylene welded linings were stronger than he thought possible. That gas welded seams made a perfect base for the high quality finish his product demanded. That cheaper processes afforded no economy in production of quality goods. That it pays to use gases of high purity for production welding.

This organization, the first to advocate high purity oxygen, has maintained a standard of purity of 99.5% or better, for many years. Member plants, located in every important industrial center, are prepared to give you neighborly service, not only on your oxygen requirements but also on your welding problems.

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Logansport—Logansport Oxygen Co.
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†*Trenton—International Oxygen Co.

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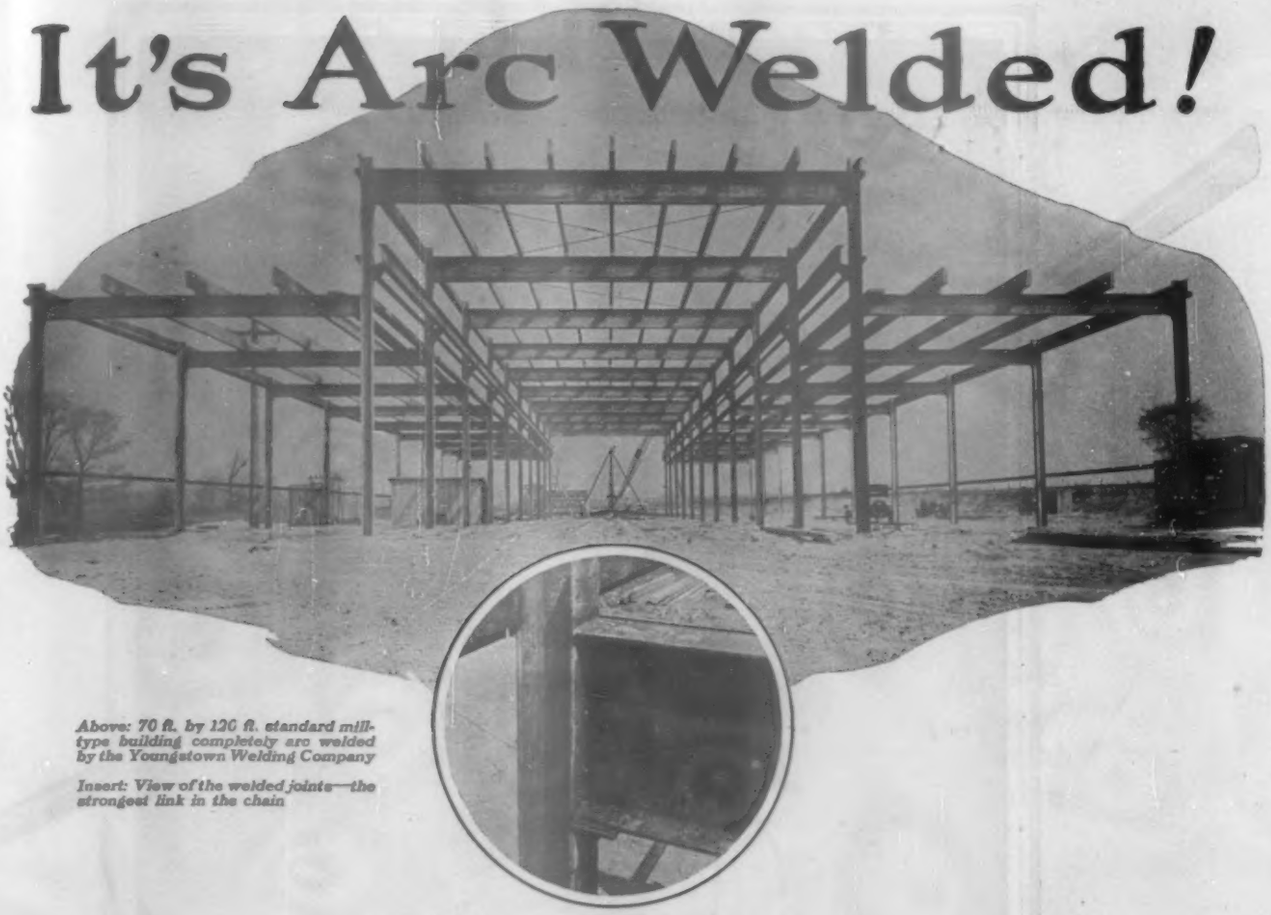
*Signifies Warehouses.
†Plants and warehouses indicated can supply Hydrogen.

Gas Products Association
140 So. Dearborn St. Chicago, Ill.

First to Advocate High Purity Oxygen

It's Arc Welded!



Above: 70 ft. by 120 ft. standard mill-type building completely arc welded by the Youngstown Welding Company

Insert: View of the welded joints—the strongest link in the chain

7 men did it—in 15 days. They used two arc welders, a burning outfit, a welded derrick, and a tractor. Not one rivet or bolt was used in fabrication or erection.

Total cost of fabrication and erection.....$530
Estimate for similar riveted job (*erection only*)...$540

Fabrication by arc welding means these practical advantages:

- Engineering work greatly simplified
- Elaborate auxiliary drawings eliminated
- Structural shop eliminated—all work done in the field
- Handling charges reduced—materials shipped directly from mill to job
- Large saving in materials
- Flexibility—changes in design during construction easily made with no waste of materials
- Field equipment simple and inexpensive—total for above job, $3000

This is just a beginning. Experience will bring greater simplification, greater speed, greater economies. Your nearest G-E office will be glad to give you the complete details of this job and much valuable information as to the G-E welder best suited to the fabrication of structural steel. Write or phone.

General Electric furnishes to the Welding Industry:

- WD Arc Welders—designed for one operator
- Constant Potential Sets—for several operators
- Arc Welding Resistors—for mining and traction companies
- Automatic Sets—for repetition work

Complete information and bulletins available at your nearest G-E office.

530-27

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GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

Special Distributors for G-E Welding Electrodes

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GENERAL

MERCHANDISE DEPARTMENT

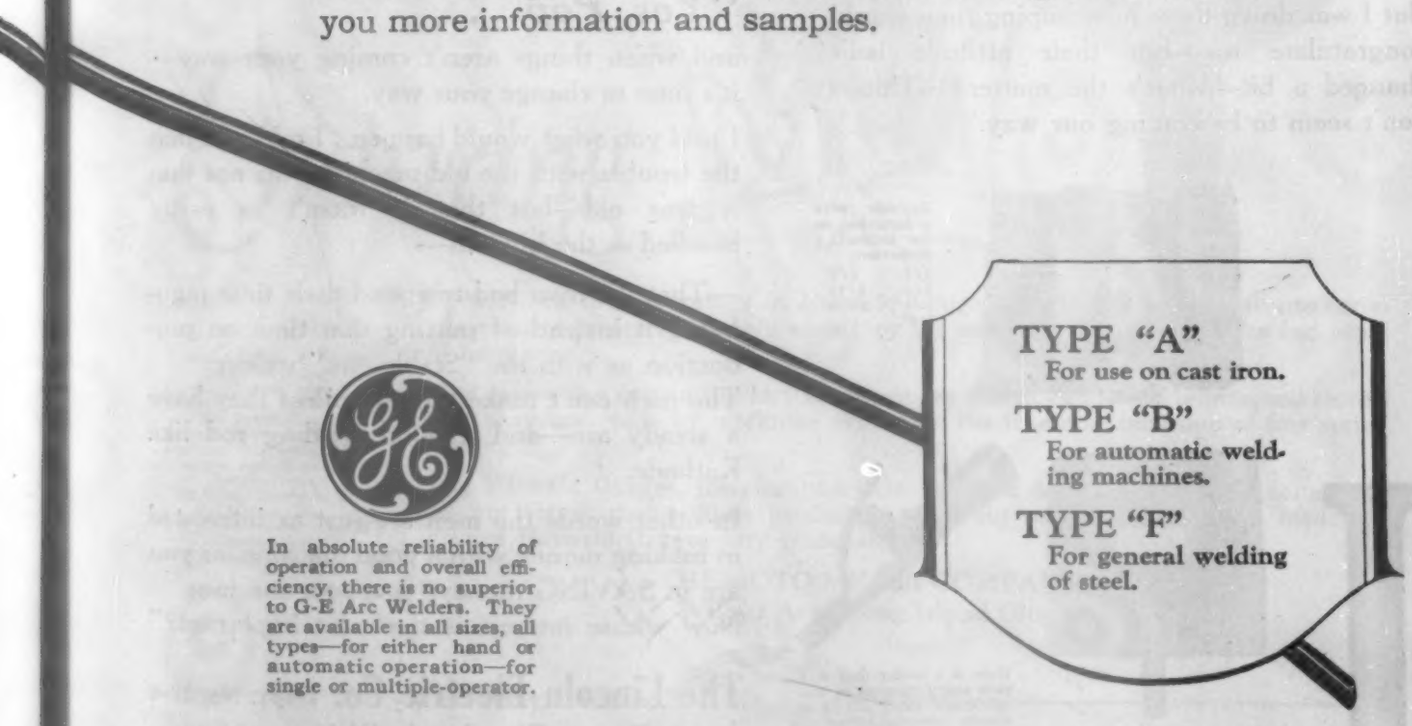
The Difference is in the Treatment

Ordinary welding wire has minute pores filled with moisture and hydrogen which cause tiny explosions—sputtering—dissipation of the metal.

The base wire of Type "F", G-E Welding Electrode alone is a good bare electrode. By a special General Electric process, moisture and hydrogen are reduced to an absolute minimum. Stabilizing substances become a part of the electrode.

The arc is much more stable. It is more concentrated.

Naturally, an operator working with Type "F", G-E Welding Electrode can produce better work and more of it. Doesn't this suggest real economy? Any of the special G-E Welding Electrode Distributors will be glad to give you more information and samples.



TYPE "A"
For use on cast iron.

TYPE "B"
For automatic welding machines.

TYPE "F"
For general welding of steel.

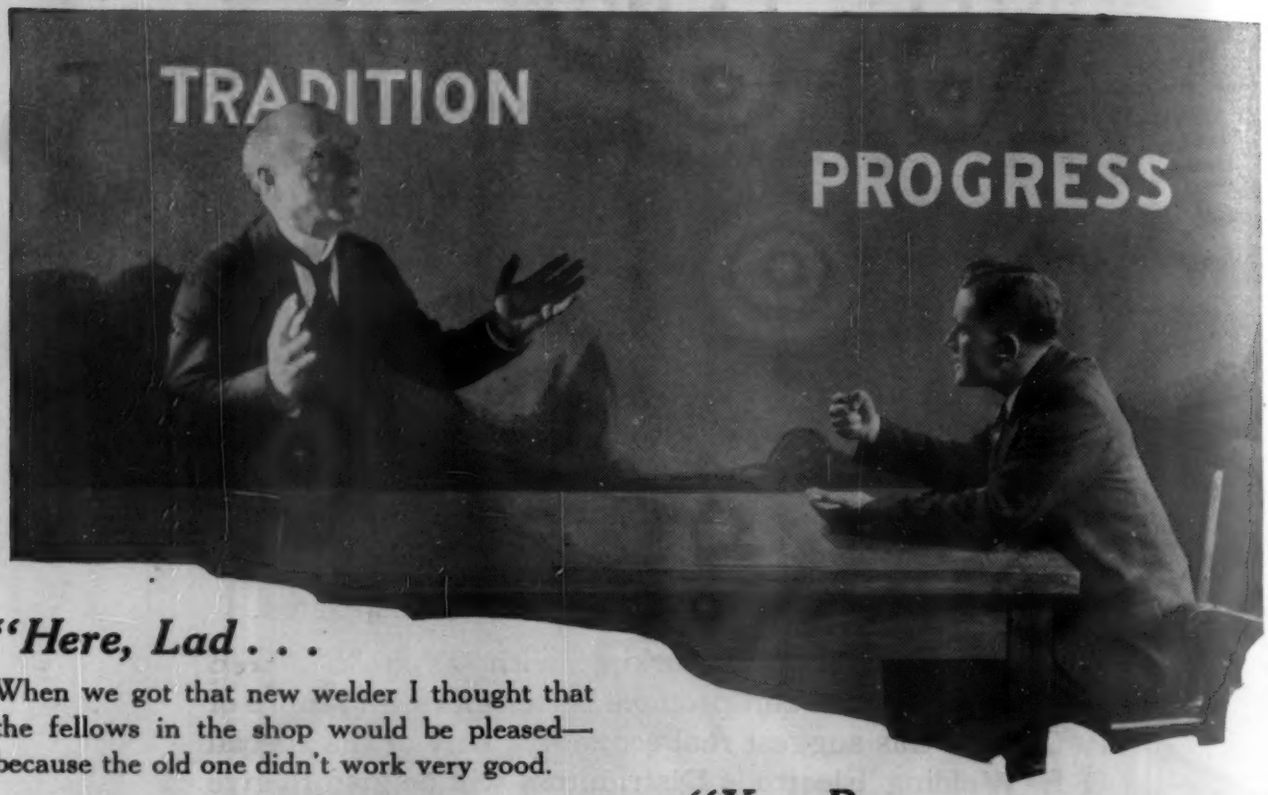
In absolute reliability of operation and overall efficiency, there is no superior to G-E Arc Welders. They are available in all sizes, all types—for either hand or automatic operation—for single or multiple-operator.

550-17

ELECTRIC

BRIDGEPORT, CONNECTICUT

Pop Thought Any Welder Would Do



"Here, Lad . . .

When we got that new welder I thought that the fellows in the shop would be pleased—because the old one didn't work very good.

But I was down there now hoping they would congratulate me—but their attitude isn't changed a bit—what's the matter?—Things don't seem to be coming our way."

Kathode wire is furnished in the following diameters: 3/32", 1/8", 5/32", 3/16", 1/4", 5/16", 3/8".

Lincoln Shields are absolutely leak-proof.

Here is a holder that will save many minutes of the operator's time. It is a simple, powerful clamp in which the electrode is firmly held.

"Yes, Pop . . .

and when things aren't coming your way—it's time to change your way.

I told you what would happen. I told you that the trouble with the old machine was not that it was old—but that it wasn't as easily handled as the Lincoln—

—That the men had to spend their time regulating it instead of putting that time on production as with the "Stable-Arc" welder. The men can't make money unless they have a steady arc—and a good welding rod like Kathode.

In other words the men are just as interested in **making** money with a **good** machine, as you are in SAVING money on a **poor** machine. Now whose interest is the most important?"

The Lincoln Electric Co. Dept. No. 27-6
Cleveland, Ohio

WF-7

LINCOLN "Stable Arc" WELDER

"The Four Quarters of the World" A famous bronze by Jean-Baptiste Carpeaux located in the Luxembourg Garden.

Enduring

THE fine bronze springs in Natweld Gauges are extremely responsive to variations in pressure, not only when they are new, but also after months and years of hard service.

The secret lies first in the fact that they are made of enduring bronze, and second that they are made by workmen skilled in the true craftsmanship of fine spring making.

Use Natweld Gauges, therefore, because they are dependable. At the same time do not forget that volume production and big sales together have made the cost of Natweld Gauges very reasonable.

THE MOTO METER COMPANY, INC.
Wilbur Ave., Long Island City, N. Y.

National Gauge & Equipment Division,
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Chicago Office,
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Representative for Illinois, Indiana, Wisconsin, Minnesota and Missouri
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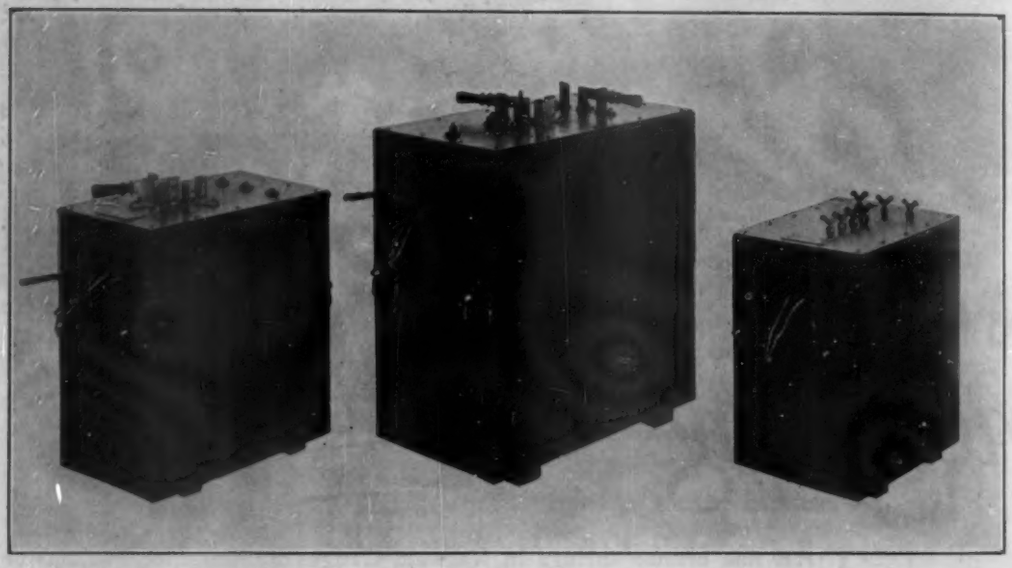
NATWELD GAUGES

If you were equipped with an

OWEN INDUCTION ARC WELDER

you could weld many jobs that you now believe impossible to repair



TYPE A. H. D.
50 to 200 Welding Amperes
Weight, approx. 290 lbs.
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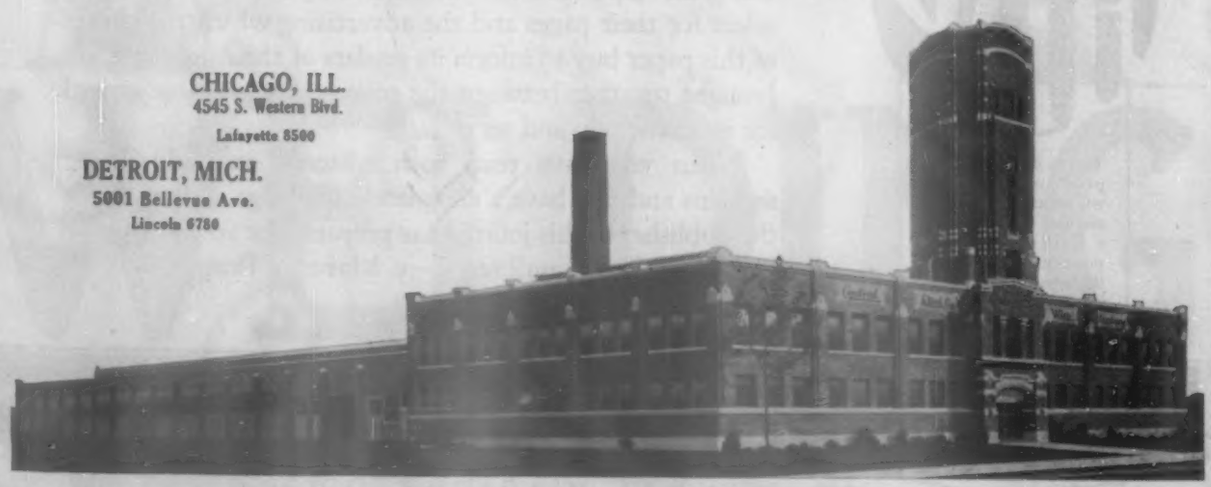

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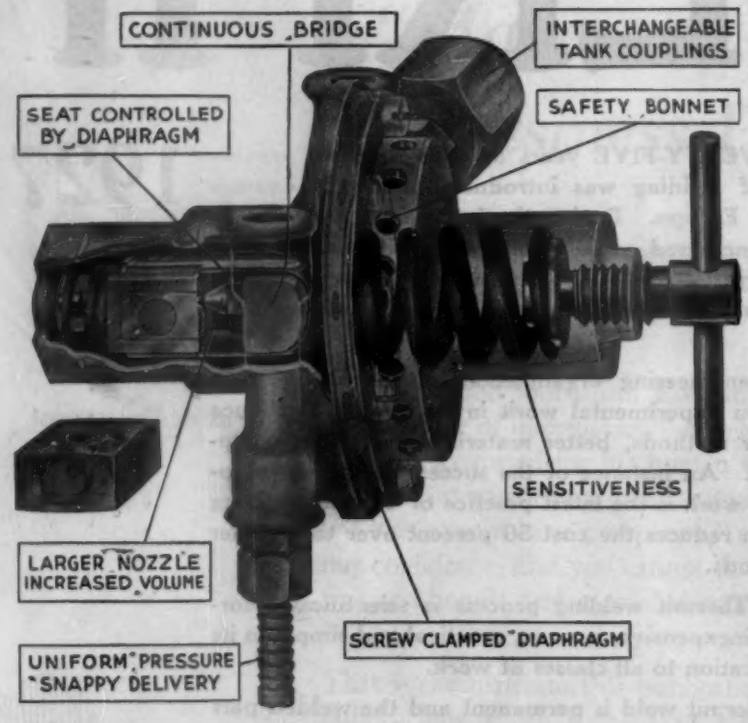

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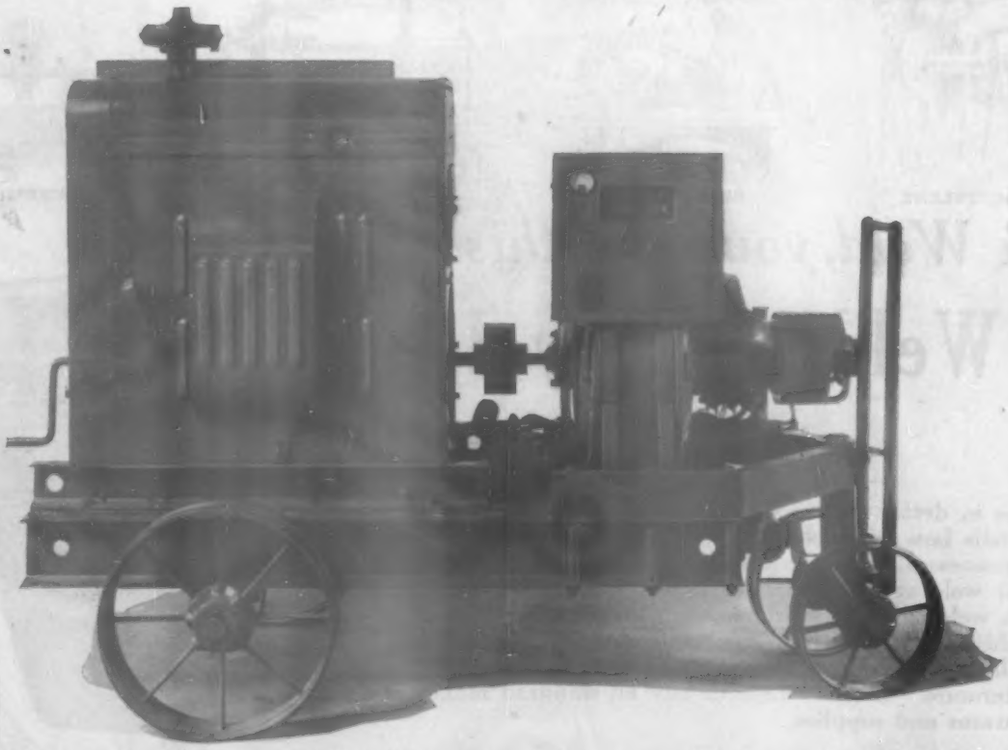

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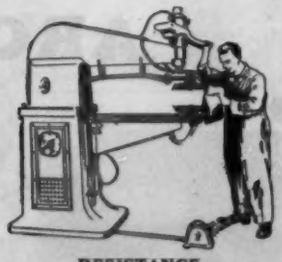

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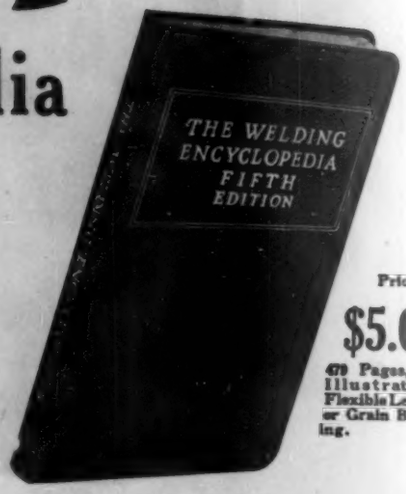

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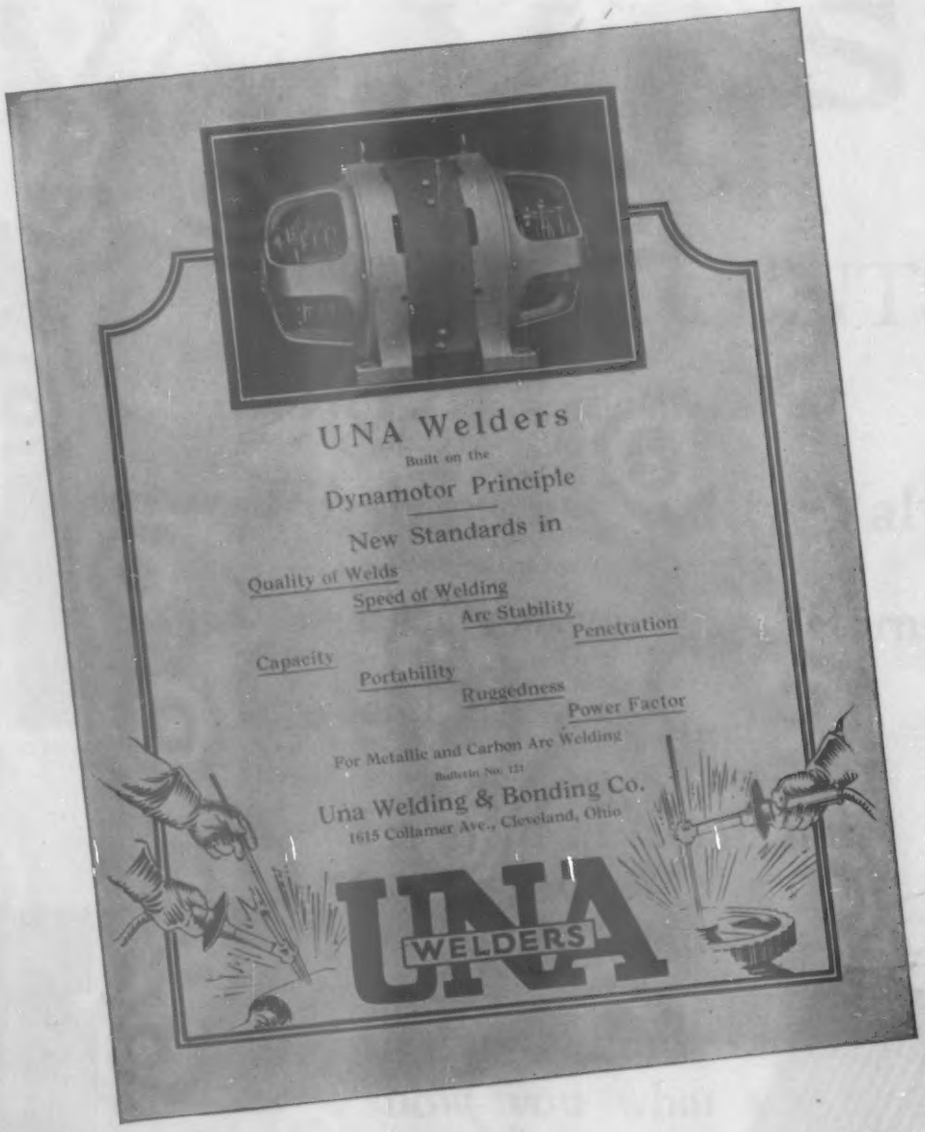

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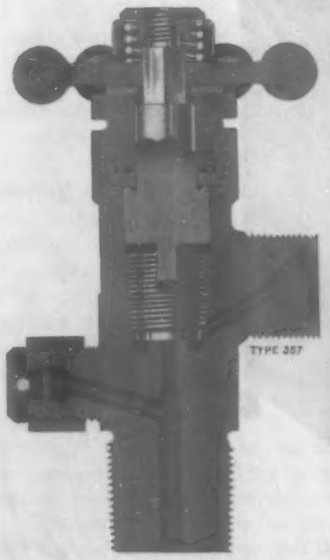

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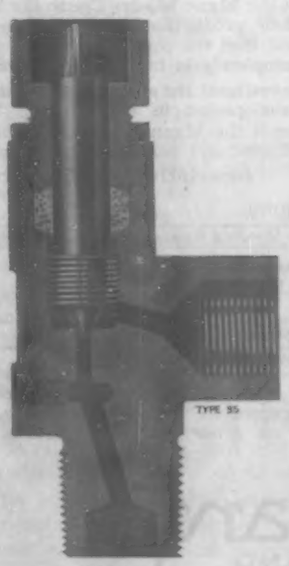

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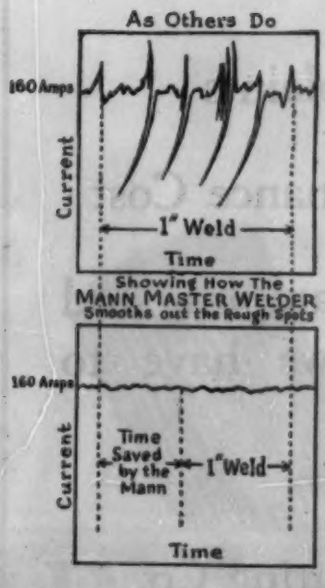

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200	28"	24"	12"	37"	36"	12"	20-200	20-400	390 Lbs.	710 Lbs.
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EDITORIAL

He Trusted Welded Joints

LINDBERGH staked his life and fortune on a flawless weld and found his judgment amply confirmed. When life itself depended on perfect welds he placed his stamp of approval on welded joints and personally supervised the all-welded construction of the "Spirit of St. Louis" in the plant where it was manufactured. And even though every ounce of weight counted, no alterations were necessary after the test flight. The essential lightness had been accomplished without sacrificing strength. It is doubtful if the operators who worked on this construction realized even to a small degree to what extent their work was destined to make history. The welding industry has reason to be proud of these men whose high spirit of craftsmanship held their work to a standard that proved worthy of extraordinary trust and confidence. It can also be proud of having completely justified the confidence placed in welded joints by America's hero.

House Heating with Gas on Increase

THE public is rapidly accepting gas as the fuel for house heating, according to a recent announcement of the American Gas Association, commenting on the phenomenal growth of this use for gas in the year 1926.

"Five years ago the manufacturers of gas-fired house heating equipment made most of their sales in territories served by natural gas," says the report. "Today the condition has been absolutely reversed. The manufacturers sell more gas furnaces and boilers in manufactured gas territory.

"House heating is becoming an increasingly important factor of every gas company's business. This ultra modern method of heating seems to be repeating American experience with other innovations. The electric light was not cheaper than the gas light, nor was the automobile cheaper than the horse and wagon. Each of these luxuries won out for other reasons, and there is no doubt that gas heating is winning out in the present day because it offers to the home owner or home renter a method of heating that is without rival.

"Gas eliminates dirt, storage, handling, attention, and other items that are old stories to the man who has heating worries on his mind. When homes are properly constructed and insulated to conserve heat, gas-fired heating supplies incomparable comfort and convenience and cleanliness at no greater expense than the bare cost of other fuels."

In Chicago, sales of gas for house heating increased 70% in 1926, according to a statement recently made by Mr. Insull, President of the Peoples' Gas Light and Coke Company, and published in the year book of the company.

Many gas companies will have important and extensive changes to make in their present distributing equipment if the demand for gas continues to increase in this proportion. The welding industry will watch this progress with interest, for it has much to offer the gas manufacturers.

The Fall Meeting at Detroit

IT IS estimated that over 25,000 manufacturing executives and scientists of the metal-working and metal treating industries from every state in the Union, Canada and many foreign countries, will assemble in Detroit the week of September 19th to participate in the numerous technical sessions to be held and to attend the National Steel and Machine Tool Exposition. It is seldom that four national technical societies interested in the metal industry, convene simultaneously in the same city, yet the five days of the week of September 19th will witness such an event at Detroit. The technical sessions of the American Society for Steel Treating will include the manufacture, use and treatment of iron and steel; while the technical sessions of the Institute of Metals will include the manufacture, use and treatment of non-ferrous materials. The Production Meeting of the Society of Automotive Engineers will embrace papers covering the latest scientific methods of production in all departments of manufacture including the use of machinery, machine tools, inspection and treatment of materials. In addition, the American Welding Society will have a comprehensive program on the latest developments and uses of welding equipment and material and show the great advances made in the welding industry. More than 300 firms from all of the metal-working centers of the United States and some foreign countries will use 85,000 square feet to demonstrate their equipment under actual operating conditions and it will be the largest factory equipment exposition ever held in America. The exposition combined with the national meetings of four technical societies, providing facilities for securing technical information from both the theoretical and practical standpoints, should draw to Detroit one of the largest and most representative gatherings of the metal industry ever assembled.

Not Welded

WELDING was under discussion and the unbeliever was present. He shook his head. He related what had happened to some welded tanks he had seen. But his remarks were fully answered by the statement that those tanks were *not welded*. There is only one kind of weld and that is a good weld; the rest are not welds. Over and over it has been shown possible to put men to work with full confidence that they will make good welds. It is even common now to have big jobs put into service without test because the welder's ability is known and the specifications are so clear that there is only the remotest chance of failure or dissatisfaction. You don't hear of failures on work that is properly planned. Most failures are primarily failures to weld.

The Mokelumne Pipe Line

DURING the past year the advisability of welding large pipe lines has been questioned in several quarters, on account of more or less incomplete reports of failures which occured in the ninety-mile Mokelumne line. Prominent engineers in the welding industry have held their peace with commendable patience and good sense, waiting for more definite and significant details of the project to be published. Now that a clearer picture of the operation itself and of the reported failures has been presented, it does not appear that welding was fundamentally to blame. On the contrary, welding seems to have made a somewhat better showing than riveting. More important than this fact, however, is the indication that many of the failures in welded joints might have been prevented by four precautions; namely, by welding at night, by better choice of filler rod, by normalizing the welds, and by laying the pipe properly with respect to the temperature conditions encountered. Another precaution is suggested in a portion of the report which shows unfavorable results following when the welders were hurried on the job. With these suggestions to consider, users and prospective users must realize that a welding project of this magnitude requires the application of engineering skill to make it successful. If the welds had been a little better made in the first part of the line the pipe itself would probably have failed in more cases, and the true cause would have been better understood. Further trials should certainly be made before the line is completed, and undoubtedly will be made, to determine the result of establishing more favorable conditions for welding.

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THERE are few pipe systems in which an absolutely tight joint, and one that will remain tight with a minimum of attention, is as important as in the case of a refrigerating plant. Carrying gases, sometimes poisonous, under extremely high pressures, considerable responsibility is placed upon the pipe joints.

A consideration of the principle of operation of a mechanical refrigerating system shows clearly why every connection must be gas tight. The compressor, or ice machine, compresses the gas (either ammonia, sulphur dioxide, or carbonic anhydride) to a pressure of 800 to 1,200 lbs. per square inch, and

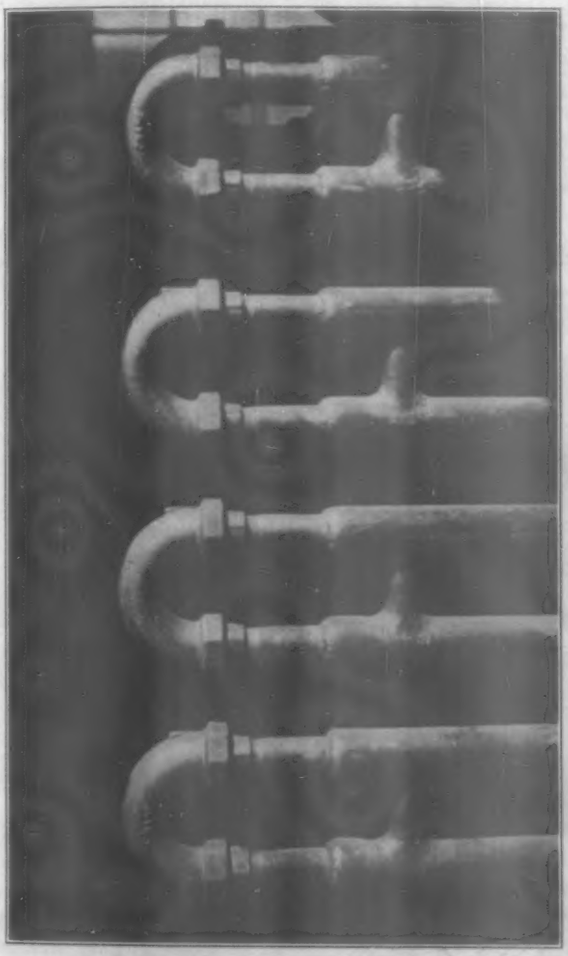


Fig. 1. Welded Connections on Condenser Coils.

delivers it to the condenser, where water is used to carry off the heat of the compressed gas, liquefying it. The liquid, by use of a regulating valve, is suddenly expanded as a gas into the evaporator or cooling coils, where the gas absorbs heat from the surrounding atmosphere or liquid, thereby producing refrigeration. The saturated gas is then delivered to the compressor and the same cycle of operation is repeated.

Not only the high pressure required but also the sudden changes in both pressure and temperature within a few feet of pipe put any joint to a severe test. The pressure drops several hundred pounds and the temperature at least sixty degrees in the vicinity of the expansion valve. Before the development of welding (and to this day in many refrigerating plants) hundreds of standard fittings and special couplings and flanges were required to assemble the entire system. That meant not only a great expenditure of time and money

Fig. 2. Assembly of Suction Header.

in erecting, but also a perpetual source of trouble from leakage, requiring constant attention to screwed fittings, packings, and so forth, with reduced efficiency of the compression and expansion systems.

Among the pioneers in the application of welding to refrigeration apparatus were the Wittenmeier Machinery Company, of Chicago, who have been welding their double-pipe condensers and other units since 1918 with complete success. The Wittenmeier condenser is an extremely interesting ex-

Fig. 3. Condensers Installed in Bismarck Hotel.

ample of what can be accomplished in simplifying construction through the use of welding. The condenser consists chiefly of a coil of two pipes, one inside the other, with cold water circulating through the inner pipe and the hot carbonic anhydride gas from the compressor traveling in the opposite direction between the two pipes. The outer is 2-inch, extra-heavy, the inner is 1¼-inch standard, both of steel. Since a single coil contains ten or more lengths of this double pipe,

a special fitting is required to connect the lengths in such a way that the resistance to the flow of the counter-currents will be as small as possible.

A flanged double fitting of semi-steel, weighing 50 lbs., had formerly been used for making these connections. The high grade of packing required, the time consumed in assembling these flange joints, and in testing each connection separately, and the loss on account of defective castings, which amounted to more than ten per cent, made this a costly means of assembling the condensor. When completed, it was of massive construction, with the twenty or more heavy fittings and the additional supports required for this extra weight. From the standpoint of operation, the fact that the condenser demanded constant attention to keep the joints gas tight and water tight increased the maintenance cost and

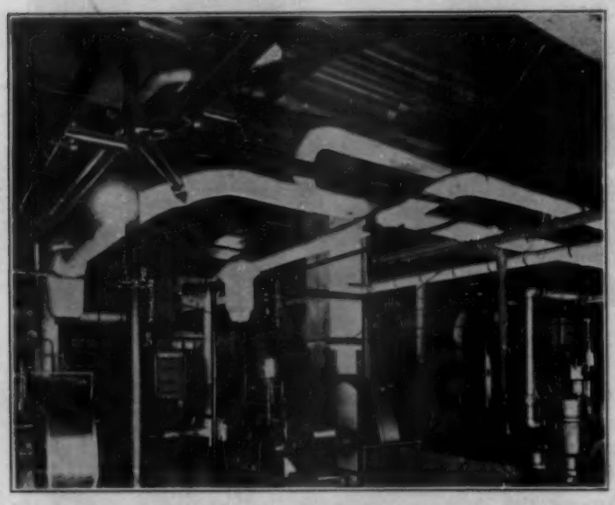


Fig. 4. Ice Machines and Welded Gas Lines.

decreased the efficiency of this part of the system. Yet this connection was the best that had been devised.

What was true of the condenser was likewise true to a varying degree of the other units, since flange unions were necessary at numerous points in the plant. On the liquid receiver, water header and suction header, not only flanged but screwed connections were a source of trouble on account of the high pressures carried.

The search for a way to overcome this loss led to the consideration of welding as a possibility. The result has been gratifying from every standpoint, and now practically every joint on the gas system in a Wittenmeier installation is welded, not only in the apparatus itself but in the lines connecting the various units. Loss through leakage has been practically eliminated and maintenance costs have been substantially reduced.

The extreme simplicity of design of the new welded condenser is clearly shown in Figures 1 and 3. Each section of the coil is made up by arc welding the end of the larger, shorter pipe to the outside of the smaller pipe a few inches back from each end. This leaves the outside pipe closed at both ends, with a clearance of about $\frac{1}{16}$ in. between the two, the gas passing through this space and into the next section of the coil through a short nipple welded to both sections, as shown. The smaller pipe, carrying the water for cooling the gas, is connected to the next section with a U-bend fitted with standard unions. Since the pressure here is only that of the city water system, little trouble is experienced at this connection. On the gas line through the condenser, however, there is not a single mechanical connection. The weight of the apparatus has been reduced about thirty per cent, and the time required for assembling and testing has been cut in half.

Another example of saving brought about by welding is found in the suction header, which formerly consisted of a steel block 5 in. square and 50 in. long, drilled through for the pipes leading from each section of the cooling coils. This necessitated bends in each line to bring them all parallel within the length of the steel block. The cost of the block and the drilling, together with the large number of connections, was much greater in both time and material than in the case of the new header, shown in Figure 2, consisting simply of a length of extra heavy steel pipe with 1¼ in. nipples welded at intervals according to the location of the outlets from the coils. To the nipples are welded the regulating valves, and the latter connected to the cooling coils, which are also entirely welded.

All other headers and the liquid receivers are made up in similar fashion, of large pipe with nipples gas welded to provide an absolutely leak-proof joint. Welding is used also in making the traps for catching scale or other solid material, even though, in this instance, the welded trap costs more. The elimination of mechanical joints and of trouble with faulty castings is a more important consideration here than that of cost.

With the exception of the condenser, which is arc welded with $\frac{5}{32}$ in. flux-coated electrode, the apparatus and the piping throughout the system are gas welded, using Torchweld torches and $\frac{1}{16}$ in. and $\frac{1}{8}$ in. rod of Norway iron, copper coated. The welding is done by skilled operators, producing welds that stand the test of 1,500 lbs. and that give a very neat appearance to the finished job.

As an engineer at the Wittenmeier plant declared, "In this plant we weld everything that can be welded." The same applies as well to the installation on the job. The illustrations show a typical plant in the Bismarck Hotel, Chicago.

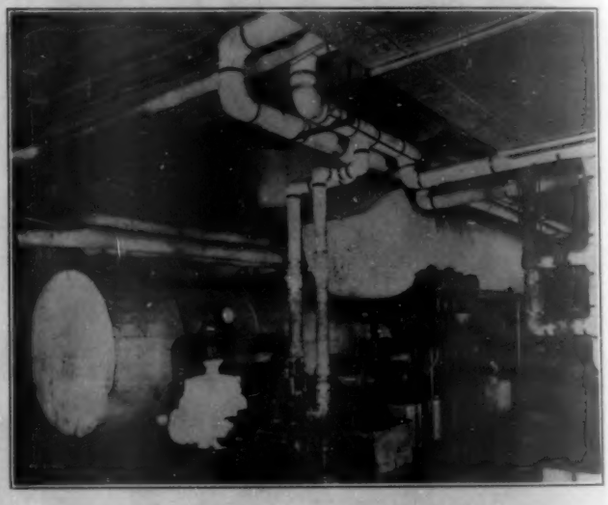


Fig. 5. Brine and Ice Water Tanks.

A similar system is installed for cooling the air in the Palace Theatre, part of the same great structure. The Bismarck plant is used for air cooling, water cooling, food storage, and for making ice and ice cream.

The wide bends and the absence of heavy fittings greatly simplify the work of insulating, and gives an overhead pipe system of pleasing appearance. The ice water and brine tanks, shown in Figure 5, are completely enclosed in the insulating material, which would be impossible were it not for the fact that the double coils in the tanks, containing several hundred feet of pipe, are welded, as are the tanks themselves. This welded construction of the coils, cutting all chance of leakage to a minimum, is of great importance on account of the inaccessibility of the coils for repairs. Engineers in charge of these plants appreciate the reduction in labor and attention required in the operating of an all-welded refrigeration system.

TELLS REASONS FOR MOKELUMNE FAILURES

Speaking before the May meeting of the American Welding Society, New York Section, Professor L. T. Jones, University of California, described the study which he and his association, Professor S. W. Weeks, made of the stresses in the Mokelumne pipe line in California, a welding project which has come in for a great deal of discussion during the past year or so.

Professor Jones first described the pipe line which is to run from the Mokelumne river to water reservoirs at Berkeley and Oakland, a distance of 90 miles. Of this distance all but 10 miles will be of 65-inch steel pipe. Acetylene welding of the girth welds of the line began early in the spring of 1926. It was the usual welding process, with the single V and a low-carbon welding rod employed. Welding was first accomplished entirely from the outside, but difficulties with breakage were encountered almost immediately. Of the first 100 girth welds, 5.5 per cent of the welding footage failed. One weld was completely broken.

As an immediate remedy, an electric metal-arc weld was placed on the inside of the girth weld. This involved the added difficulty of chipping away the protruding metal before the electric welds could be placed. It was thus necessary to procure and handle both compressed air equipment and electric welding equipment in addition to that in the field. Not a single electrically, backed-up weld has broken during the construction of the line, but as a production process it is expensive.

Some 25,000 linear feet of line thus were constructed and subjected to the 200-pound per square inch water pressure, with nearly zero leakage. As a further guard against operating stresses, not yet encountered, the girth welds were provided with five butt straps, each electrically welded across the acetylene welds.

The ditch was 7 feet wide and about 10 feet deep in order that the line might be carried below existing irrigation systems. After the pipe was placed in the ditch by a crane, it was held in alignment by a system of wedge-shaped keys and slotted plates. Longitudinally, they were held in position by short welds. Fifteen to 25 pipe sections, each 30 feet long were laid and welded each day. Instantly after the welding, the middle of each section was back-filled, the welds being left exposed for subsequent tarring and wrapping.

Prof. Jones divided the stresses into two groups: Operating stresses, which comprise water stress, cold water stress and poisson stress; and construction stresses, which comprise residual, shearing, gravitational, differential temperature and line stresses.

Asserting that most difficulties encountered were due to expansion under the action of the sun and to consequent contraction during the night, he displayed a chart showing the air temperature and also the temperature of the top and of the bottom of the pipe as it lay ready for welding. He showed there was a large differential temperature, nearly 50 degrees Fahr., between the top and bottom of the pipe during the middle of the day.

One of the aggravating consequences of the sun's heat, was the daily motion of the free ends of the line under contraction. Each forenoon the pipe lengthened a few inches and then contracted a like amount during the late afternoon and evening. Back-filling functions both by controlling temperature and by placing a heavy load on the pipe. A study of the motion of pipe was necessary in order to arrive at conclusions regarding stresses encountered. A recording motion meter was devised which gave a continuous record of the motion of the pipe.

The constructional stresses are less simple than the operating stresses, but are largely under engineers' control. Residual stress results from progressive deformation of metal as welding proceeds. In the construction of such a large pipe line, he said, it is imperative that each of the 30-foot sections, weighing 5 tons, shall lie in its final position during the time of welding. All the girth welds are thus bell-hole welds.

A table showing a number of breaks, and the average linear feet of break in groups of 100 welds indicated a decrease in the breaks in both number and length as the work progressed, and the only setbacks that occurred were when an attempt was made to hurry the welders. Attention was called to the fact that in the first 371 riveted joints undertaken since welding was discontinued, it was necessary to remove 4.54 per cent of riveted footage, whereas only 4.44 per cent of welding had failed in the first 371 joints under that process.

Professor Jones stated his belief that by welding at night, using a low-carbon vanadium rod, or a similar suitable rod, by normalizing the metal of the weld, and by laying the pipe properly in groups of 20 with the groups joining together, there would have been only a negligible amount, if any, failures.

The 1½ miles of line that have now been electric welded, adopting in its entirety the program for a group laying and the method of avoiding differential temperature stress, have been utterly devoid of faults of any description.

200-MILE OIL PIPE LINE PRESENTS UNUSUAL PROBLEMS

Several factors combined to make unusually difficult the construction and engineering problems encountered in building an oil line from the Texas Panhandle to Ringling, Okla. To begin with, the oil has a high paraffin content, which causes it to congeal at 55 deg. F., which made it necessary to bury the line where possible to depth about 14 in. greater than any maximum depth heretofore used. Special insulation is provided where pipe is exposed to the atmosphere and during the winter months the oil must be heated.

The topographical character of the territory through which the line passes added considerably to the difficulty of location and construction. Shifting ravines and canyons, quicksand and danger from floods, a shifting riverbed, and erosive action of the earth, were a few of the difficulties which the engineers faced.

Engineering News Record of June 21 describes the procedure followed in laying this line, which is designed for a pumpage over its entire length of 24500 bbl. per 24 hr., calculated on a basis of 700 lb. pressure. There are seven pumping stations, from 28 to 42 miles apart, depending upon the topography of the country. The discharge or main line is 8 in. steel pipe in 40 foot lengths, while the suction line from the 30,000 bbl. steel working tanks at each station is 12 in. All joints are welded.

Closely following the stringing and preliminary ditching work, a gang of men lined the pipe into five-length runs by means of clamps. An acetylene generator with a capacity of 100 lb. and four oxygen cylinders supplied a gang of four men for eight hours. Four of these outfits were used, each pulled along the line by a team of horses. Welders experienced in pipe line work were used exclusively. The five-length sections held in line with the clamps were first tacked, the clamps removed, and a heavy ripple bead run around the joint.

The pipe in the runs of 200 ft. was bent to contour immediately after the welding. By placing a crawler tractor on the pipe at the point where the bend was to be made and having a gang of men walk onto the protruding pipe, overbends were easily made. The tie-in welds completing the line were made by a gang of men and a light truck carrying the oxygen and acetylene tanks, as the generator could not always be transported easily over the rough terrain. The 200 ft. lengths were turned with pipe tongs as the welding was done, while some overhead welding was necessary for the tie-in gang.

Welding a Gas Purifier

Absence of Noise Marks Erection of 60-Ton Steel Structure, Which Will Cleanse Ten Million Feet of Gas Daily

By R. K. Randall*

THE day of rivetless construction is here, not in theory but in actuality. Perhaps 52-story sturctures, such as the new Tower Building of Cleveland, are still using rivets, and the public are very much aware of that fact through the rat-tat-tat of the air hammers smashing down heated rivets. Those of us

Fig. 1. Generator Room.

who have ever been in a shipyard on a torpedo boat, tanker, or battleship which was under construction, are familiar with the inferno of several hundred air tools being used for drilling, riveting, and caulking.

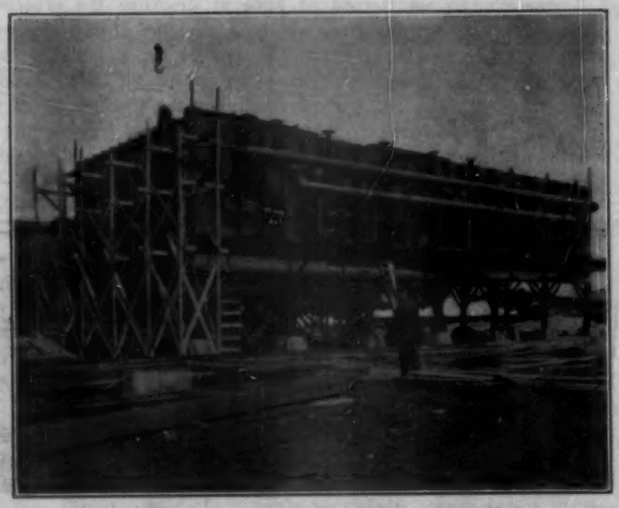


Fig. 2. A Welded Pipe Assembly.

A few days ago we made a visit to the plant of the Otis Steel Company of Cleveland, Ohio, to obtain the story of the erection of an all-welded structure weighing 60 tons, a gas purifier, which will cleanse 10,000,000 cubic feet of coke oven gas a day. This purifying, incidentally, is done by passing the coke oven gas through a pulp made by mixing iron oxide and wood shavings together. The iron oxide readily absorbs the sulphur from the coke oven gas and sends it out about 98% pure.

This particular job is being done by the Semet Solvay Co., and the engineer in charge is Mr. Harley Perry of Owasso, Michigan.

The first thing that impressed us was the absolute absence of noise. In fact, the only noise which could be heard was the sharp crack-crack-crack of arcs held by the operators, seven of whom were on the job. We first visited the power house. This power house was a simple wood building, housing a desk and rack for blue prints and the seven General Electric 300 amp. machines. Figure 1 shows the compactness of the installation.

Fig. 3. Welding Part of Cover.

Following the welding leads we came upon the structure. This structure has for a base channel beams 24"x7" upon which it rests, and is welded to the bottom plates ⅜" in thickness. These bottom plates are laid with a 2" lap tacked at various places and then welded both inside and out. It is interesting to note that these bottom plates showed practically no distortion due to welding.

The side plates are also ⅜" in thickness and the same method of lapping and welding was applied. However, on the inside they were welded to the upright eye-beams by the intermittent process instead of the entire height of the tank. A great deal of the work was done on the ground and then hoisted into position as an assembled unit, and Figure 3 shows one of the covers being welded preparatory to installation as a complete unit.

Oxy-acetylene cutting outfits were distributed freely around the work so that when a piece did not fit, a cut was quickly made to make it fit. The tank is made up of three compartments 26'x35'x13'. When the job is completed each of these compartments will be tested with a pressure of 6 lbs. per square inch.

A glance at Figure 4 will show the perfect shape of a cover. The eye-beams shown in the picture were made by cutting a "Vee" from the beam, the "Vee" being removed, the bar under

Director, Cleveland Welding School.

its own weight closed and was then welded.

This method certainly is superior to the old-fashioned and cumbersome method of bending bars on a bending floor with dogs. The partition plates are ½" thick and welded at top and bottom

a day. Most of the welders were recruited from Cleveland after a very careful search, and the old story of the human element again appeared. Plenty of men could be found who could deposit metal on work lying in a flat position, but the moment ver-

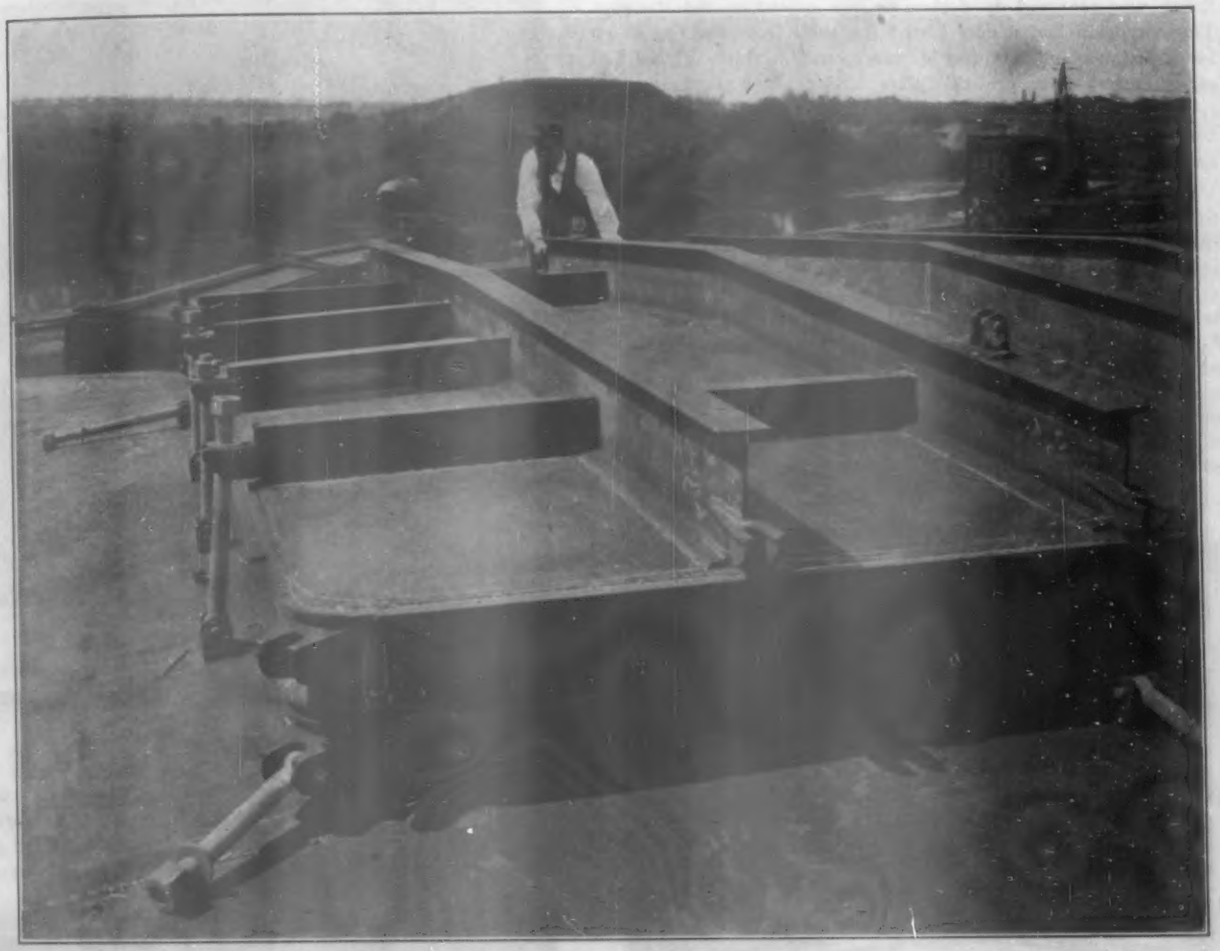


Fig. 4. Larger View of Cover, Showing Perfect Alignment.

Fig. 5. Inside View of Purifier.

and sides to the 3/16" shell; 1/8" electrodes was the size electrode used for most of the work, although on some of the flat work 5/32" was used for speed. There are 14 welders on the job, seven day and seven night, who deposit on the average of 400 lbs. of metal

tical, horizontal, or overhead conditions were made the operators fell flat. This one point brings out the need for proper training in these things before structural work of any kind is attempted. Every operator must be trained in manipulating his arc at unusual angles before he can be trusted to work on structures of this nature. The welders on the job, incidentally, have averaged around $100.00 a week on this job, which, by the way, should make it an incentive for every operator to become an "ace."

The pipes shown in Figure 2 were all welded at Owasso, Michigan, at the plant of the Steele Engineering Co., the final tying in welds being made on the job. This particular job is being erected in the Cuyahoga River Valley right near where the Clark Avenue bridge spans the East and West sides of Cleveland, and at night the reflection of the arc lighting up the canyon gives one the effect of a very spectacular miniature electric storm, and it is interesting to note the numbers of people who stop in transit over the bridge and wonder and speculate on what it is all about.

This type of job certainly opens up new fields to the welding industry and will go a long way towards getting the confidence of architects and engineers. These pictures were taken 26 days after starting of the job, and it is anticipated the total time consumed in the erection of this gas purifier will not exceed 45 days.

WELDING LENGTHENS LIFE OF LARGE STACK

When it was discovered that a 320-foot stack had become badly corroded on the inside on account of faulty lining, allowing flue gases and moisture to attack the shell, the brick lining was removed to determine the extent of the damage. The corrosion had deeply pitted the shell from the top down for a distance of sixty feet or more, and in thirty places had eaten entirely through the plate. Since it was planned to replace the whole series of stacks in a few years, it was hardly advisable to rebuild this stack, which was obviously unsafe, however, in this condition.

In addition to patching the holes, it was found necessary to reinforce the stack with stiffeners. Riveting was out of the question because of the thinness of the sheets in many places. Bolting the stiffeners on the outside of the stack, using large washers to grip the weakened metal, was at first

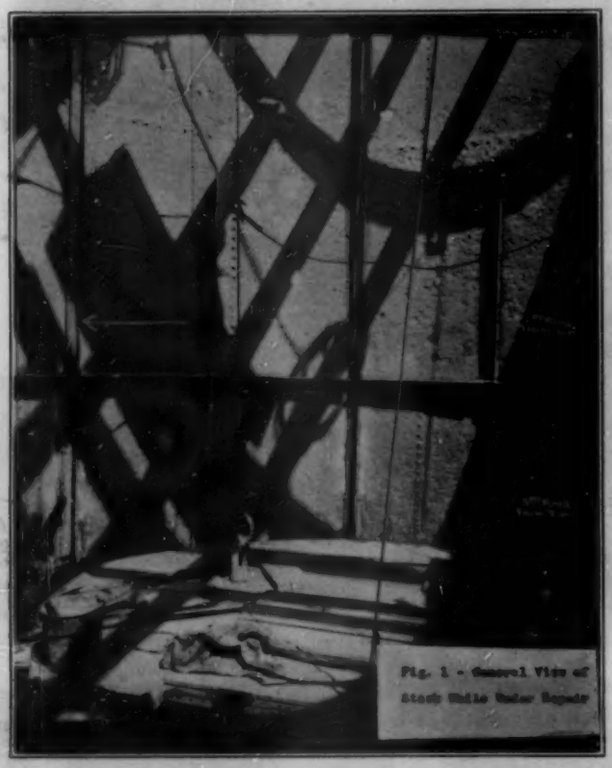


Fig. 1. Interior of Stack, Showing Condition of Sheets.

considered. This would have necessitated building a scaffold or working from a boatswain's chair on the outside, and the completed job would have made the stack appear conspicuously different from the others in line.

Then someone suggested welding. When it was considered that by this method the stiffeners and patches could be attached more securely, regardless of the thickness of the sheets, and that all of the work could be done from a platform suspended on the inside, without in any way changing the exterior appearance, welding was decided upon as the logical method.

Starting five sheets, or 65 feet, from the top, sixteen stiffeners were spaced around the inside of the stack. Angle irons, 3"x3"x$\frac{5}{16}$", were arc welded to the sheets, the lengths overlapped 12 inches at the ends and welded, giving continuous bracing with no reduction in the strength of the stiffeners where the lengths were joined. The welds were staggered, as is clearly shown in the illustrations, each weld extending for about a foot. The rings were notched with the torch the width of the angles, and dutchmen were afterward welded to the angle and to the ring. At the riveted joint between the sheets, the angles were heated and hammered to conform to the joint, so as to keep the angles tight against the stack, thus eliminating fillers and saving considerable welding.

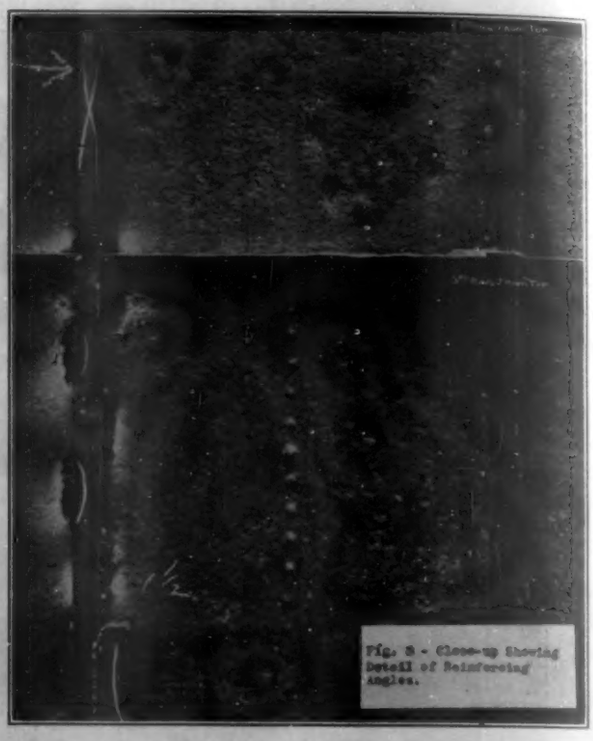


Fig. 3 - Close-up Showing Detail of Reinforcing Angles.

Fig. 3. How Reinforcing Angles Were Applied.

After the work on these five sheets had been completed, it was decided that the reinforcing should not end so abruptly, since this put additional strain at the bottom of the fifth sheet. Accordingly, eight alternate angles were extended one more

Fig. 2. A Few of the Thirty Patches.

sheet, making the total length of the reinforced section over eighty feet.

The entire job, including the sixteen stiffeners, thirty patches, and seventy-two dutchmen, required over 1,500 feet of welding, and was completed in three weeks' time. The company's engineers estimate that the life of the stack has been lengthened at least ten years.

Shop Tools Made to Order

The Skilful Gas Welder Puts Knowledge of Heat Treatment to Work and Produces Serviceable Tools on Short Notice

By Will Stewart

SINCE Bert Morton had hung out his shingle, "Tools Made to Order," jobs had been coming in faster than he could handle them. The news of what Bert could do with a cutting torch, a welding torch, and odd pieces of Ford spring or other scrap, had spread like wildfire, and this evening he came out of his Repairatorium with a bag full of tools of every description, exactly according to specifications, all made since morning.

"Gotta have a helper, that's sure. Dick's back from the oil fields, and he's some welder. Guess I'll look him up tonight."

So when Bert tackled his back orders in the morning, Dick was on hand to see how he worked his magic. His first job was a hex. broached snap-on speed socket. He dug into the annealing box and fished out of the asbestos half a dozen blank sockets, and ordered the latheman to run a 5/8 in. drill through the butts. Then they were put into the furnace, and when they had come to red the nut end was dipped in the water tin and the shanks were squeezed up to egg shape.

Bert then heated a large battered punch to a bright red in the furnace and formed it roughly to shape, with the opposite sides of the tapered end flat, finally finishing it off on the grinding wheel. The socket was heated again, its butt cooled, and with the punch in the shank, the red metal was hammered to the shape of the punch.

After reheating to remove the forging strain, and annealing, Bert smoothed out the flattened oval hole with a fine cut file. Then to the grinding wheel to remove the oxide, and to the furnace for hardening, as he knew it was useless to start forging the connector until he had a socket hardened and finished to fit it in. When the socket had come to red heat, he lowered it into the hot water tank by means of a wire, moving it up and down to force the cooling medium through the inner openings.

Out of the junk bin Bert picked a section of Ford steering shaft. In one end he drilled a ½" hole, one inch deep, and cut off the shaft an inch from the end of the hole. Then into the furnace, and when the piece of shafting was red he selected two punches, one of which he drove into the shell to enlarge the hole, and then with the other forced the hole to hex. shape. Using the punch for a handle, he laid the solid end upon the anvil and flattened it out to oval, and then with the welding torch heated the metal just back of the forged end to what appeared to be bright red through the goggles, and built up a fillet a quarter of an inch high, sloping back toward the hexed end. He brought the connector barely to red in the furnace, to avoid oxidation, and as it cooled to black he water annealed it and finished it down to a forced fit on the grinding wheel. Then he drilled a 3-16" hole through the flats, half an inch back from the end.

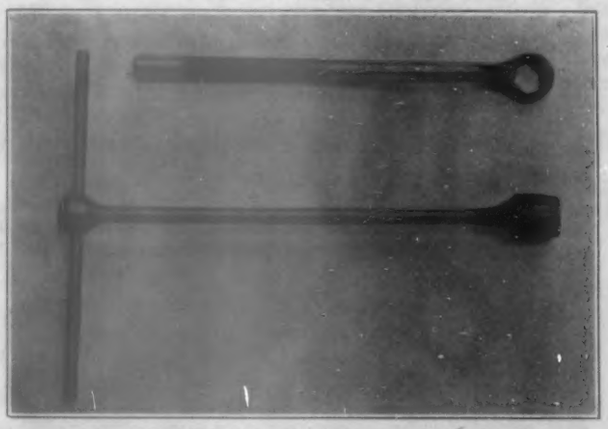
Into these holes he pressed a bit of welding clay, pressing down the overflow on each side to form a cap. He put the connector into the furnace, placing it so that the solid section would heat first, for otherwise the hexed end would not, when hardened, be tough enough to stand the twisting strain. Now he removed it from the furnace and jounced it up and down in the water tank. When cooled, he finished it down with the grinding wheel to exact fit with the test socket. Then he played the heat on the solid end, bringing it to brown on the slip end and verging to blue at the collar and purple at the hexed end. He placed a spring in the drilled hole and on each side of the spring a ball. Because of the clay, the edges of the hole were shielded from the cooling bath and remained soft enough to upset around the edges of the balls.

Dick had been watching curiously Bert's procedure in heating and hardening the tools at each step, and Bert noticed a puzzled frown on Dick's forehead as he cooled the connectors in warmed water.

"Why the corrugations?" Bert laughed.

"Was just wondering why it is that early this morning you heated these tools to bright red and now, this noon, you're heating them to just red or dark red."

"Well, there's a good reason for those different reds, but before I explain that let me hand out what I know about carbon steels. Carbon, when added to iron, unites with the iron and forms iron carbide, which is hard and brittle. Up to .80 percent of carbon, it all unites with the iron. Above that percent the carbon just sticks around, changing the structure of the steel until it is dotted with free carbon. In the fracture of a piece of high carbon steel, it looks either silvery white or slightly grayish.



Serviceable Tools Made With the Oxy-Acetylene Torch.

"If you heat the steel too hot and then chill it, those specks of carbon that were swirling around, all trying to grab a bit of iron to combine with, are suddenly stopped just where they happen to be and then show up in the fracture all scattered out without a good hold on each other.

"Now, the higher the carbon content, the lower the melting point of the steel and the greater is its hardness and brittleness when chilled suddenly. So every time a hardener gets a different piece of steel, he has to know just what per cent of carbon it contains, and what kind of work it has to do, so that he can give it just the right amount of heat.

"Red heat is generally right for 80 to 95 point carbon steels, but you have to take into account the fact that no two men's eyes see red just the same, nor does a man see red the same all through the day. See that skylight right overhead? Well, that partly explains why I was heating to different reds. The sun is high now, and to our eyes in this light the metal looks as though it wasn't brought to as high a temperature as it was this morning.

"Now, look here." Bert produced a color chart, with this note: "Red visible in dark, 725 deg. F. Red visible in twilight, 884 deg. F. Red visible in daylight, 1,077 deg. F."

"Just see what you are up against when you go at tempering high carbon steel, with 1.00 to 1.50 per cent carbon. Full cherry red is 1,375 deg. F., medium cherry is 1,250 deg. F., and dark cherry is 1,175 deg. F. Now, if a guy isn't watching, he'll forget

that his eyes are blinded by the sun or artificial light and he brings his tool up to full cherry red as his eyes see it, but instead he gets the tool bright red, and if the carbon content is high he has the grain so open it will crumble down when put in use."

"But, say," Dick piped up, "my blacksmith friend hardens different than that, and he must know his stuff, because the tools hold up. He heats them way up, dips them in water for just an instant, rubs them on a brick, and watches the bright spot till it gets to the color he wants and then sticks them in the water again."

"Yes, that method, used by blacksmiths for years, is good, but this one is better. When the smith draws the glowing tool from a flaming force, dips it, and then, before he has gotten over being blinded by the glare, forces his eyes to look for a mild color (brown, purple, or blue) he is not going to judge his heats very accurately.

"I get a laugh every once in a while when some mechanic remarks, 'That must be a good tool. Look at the fine color. I had a tool that color once, and it lasted me fine.' The joke is that I can put just as pretty a color on a piece of polished cast iron, cold rolled or wrought iron, for the color is just the oxide forming as it takes up the heat you are giving it.

"Always remember, Dick, that the hardening's the thing. Find out the carbon content of the tool you are going to harden, give it as near the proper heat as possible, play safe by heating to a deeper rather than to a higher red, and then test the tool. If it breaks, it's probably a case of improper heating, or you may have forged the metal while at too high a heat, or continued to forge it after the black came. In either case you would crush the grain, and it would show in the break in forging cracks. Carefulness pays. A piece of steel given proper hardening heat and the right method of cooling will outlast two pieces that were hardened by guess.

"But, say, while we're gassing here we're getting further behind with our tool making. Here's an order for a spark plug shell. Let's see what you can do with that while I'm finishing this socket order."

Bert took a couple of Ford magnets out of the scrap bin, and brought one of the V'd pieces to bright red, straightened it out, reheated, and then on the anvil drew one end out similar to a cold chisel. He cut the magnet off three inches back from the tip and forged three more pieces, all of different lengths. He laid the pieces in the V-blocks and with the welding torch built up one end of each, afterwards hammering to a roughly hexagonal shape, finishing down with the grinding wheel to a fit with the test socket. He drilled a 3/16-inch hole three-fourths of the way through from one of the flats, filled it with clay as before, heated and hardened each piece, and after polishing he tempered them in a pan filled with sand, drawing the formed hexes to blue and the blades to brown. After grinding down the bits to fit the slots of the screws to be used, balls were swagged in place in the drilled holes, and the bits were finished.

The next step was to heat one end of an eight-inch section of a Ford tie-rod, and, standing it on the anvil with the red end down and pounding the other end, he flared the metal out until he had finally formed a round knob. After several heats, he had forced a hole through the knob with a taper punch and eventually formed a hexed hole an inch in diameter. He added metal to the distorted ring with the welding torch until the end was about three-fourths of an inch high, and then, after heating and annealing, he smoothed up the hole to just an inch between flats. Then he reheated, and swung the socket in the oil tub so that the cooling fluid passed rapidly through the inner surfaces of the hexagon. After testing for hardness and size, he drew the handle to deep blue and the socket to brown tinged purple.

Bert produced another piece from his scrap bin in the form of a Ford steering shaft, in which he drilled a hole 2½ inches deep and then cut the shaft off at the bottom of the hole. As he had done with the drilled end of the connector, he forced each end to a hex shape with the taper punch, finished the faces with a fine file, and ventilated this skeleton socket with an oval hole half an inch from one end. Now it was possible for the mechanic to watch the cotter key holes in the connecting rod bolts when tightening up bearings, and to line up the castle nut without removing the socket.

Just then the whistle blew, and as Bert stood there surveying his morning's work, Dick came up with the spark plug shell he had welded. It was tapered, made for removing two sizes of spark plugs from the engine blocks. Bert questioned doubtingly, "Do you think the welded section is strong enough to stand the twisting strain?"

"Sure thing," Dick snapped, "the butt welded shells are now all one, and—" He paused, for his gaze had wandered to the skeleton speed socket on which Bert had spent so much of the morning. "Well, you big boob," he exclaimed, "here you go and waste your own and the latheman's time making up that ventilated socket, when all you needed to do was to cut a couple of disks, punch to size, hammer out a couple of flat pieces from a tie-rod, weld a disk to each end of the flat pieces, with the edges of these pieces an inch apart, and then harden and temper. What could be simpler?"

Bert's face betrayed his disgust with himself, and right after lunch he set to work to make up a socket according to Bert's suggestion. Then he put it to the test. With the socket he cinched down on a bolt in the vise, determined either to break the socket or to twist off the threaded end of the bolt with the nut. When, at last, the nut popped off, the socket, though slightly twisted, was still serviceable. It was evident that the welded socket was equal to the job it was made for. And it was made up in a fraction of the time required for the one he had made that morning. Bert sure keeps his eyes open now for a chance to save time and patience by welding.

GAS WELDING VERSUS FLANGE JOINTS FOR STEAM LINES

Convincing arguments for the replacement of flange joints by welding are presented by Glenn O. Carter of the Linde Air Products Co. in an article in *Power*. It is pointed out that where a modern steam line is equipped with adequate expansion facilities, the stresses are never high even at the bends. On the other hand, the stresses in an eight-inch oil pipe line operating at 700 lb. pressure, laid in warm weather, reach 15,000 to 20,000 lb. per sq. in. during extreme winter weather. At least two companies have a quarter of a million joints each and have not had a failure. Hydraulic, air and gas lines are also operated at high pressures, some straight-away, some twisting and turning around plants. Failure of welded joints is unheard of in many large works. Steam engineers who provide amply for expansion and contraction can therefore assume that past history of welded joints is entirely satisfactory.

Successful welding, however, presupposes proper procedure control by checking workmanship of the welder, and the grade of filler rod, using a type of joint suitable for welding (of which the butt weld is to be preferred), fitting the part together properly, and after welding applying a test by hammering and looking for pinhole leaks. Mr. Carter remarks incidentally that it is such procedure control methods that have done much to raise the status of welding within a very few years to the point where the process is used with confidence by engineers.

Beside obtaining a joint that solves all of the problems pertaining to the carrying of high steam pressures at high temperatures, there are other distinct advantages gained by welding, such as making possible complete insulation of all joints, as well as reducing the radiating surface. Considerable savings are also effected in drawing layouts, which need only show outside dimensions of covered pipe as a check on clearance, and location of valves and expansion joints. Much welding and insulating can also be done away from the final location.

Making Gears by Arc Welding

A Radical Departure from Conventional Methods, Which May Well Lead to Unforeseen Economies in Machine Design

A SPOKE may seem as essential in a gear as the gear is to the machine it operates, so the introduction of a gear without spokes appears at first glance as a deliberate attempt to get rid of them. The fact is that this radical change in appearance is only an incident in the change from cast gear blanks to gear blanks made of welded steel. The true significance of the change is better appreciated when more important features of the two types of gears are compared. Here are some of them for a 45-inch gear:

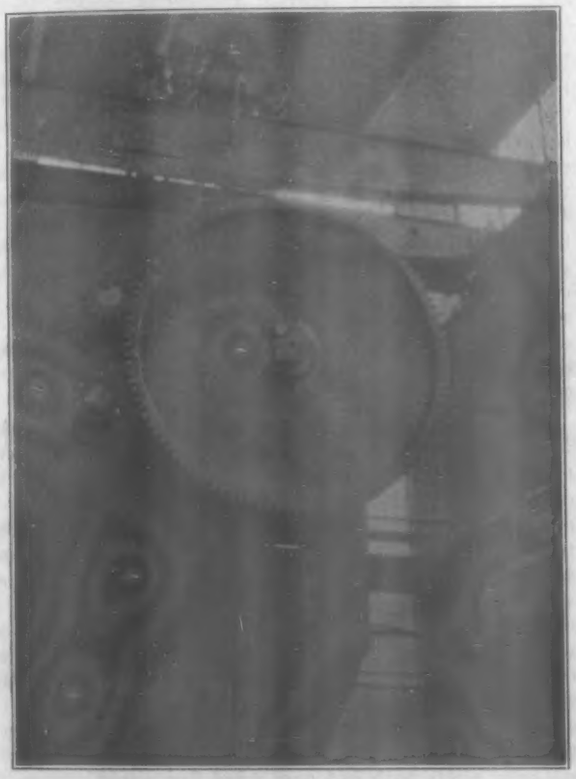


Fig. 1. 45-Inch Welded Steel Gear.

	Welded Gear	Cast Iron Gear	Cast Steel Gear
Cost of Blank	$23.00*	$40.00	$ 75.00
Cost of Finished Gear	48.00*	60.00	105.00
Finishing Time	12 hrs.	10 hrs.	14½ hrs.
Clearance Allowed for Turning	1/8" to 1/16"	¾"	5/8"

However interesting these figures may be to the machine designer, they do not tell the whole story. Back of the development of a new type of gear for heavy machines is a fundamental thought, that of progress overcoming tradition.

The changes which are being made in heavy duty machinery adapted to present day mass production requirements are best appreciated by factory executives, to whom improvements represent the solution of serious production problems. The casual visitor in a modern manufacturing plant is duly impressed by the display of ingenious machines and by comparisons of their operations with methods used to perform the same work a couple of decades ago, and goes on his way marveling at man's apparently endless power to lighten labor, reduce costs and speed operations through mechanical devices. But to the plant manager these mechanical advances are more than interesting—they are a vital necessity. Competition, both direct and indirect, shows such tireless activity in the market places as to force upon the production centers the duty of backing up the sales forces. Under such conditions the engineers in charge of productive units cannot afford to let production methods stand still, they must seek improvement continually.

If the machinery used for the production of any commodity fifty years ago were compared with the machinery used for producing it today there would probably be a very noticeable lack of similarity, and the changes may have come about in one of two ways. Unexpected inventions or discoveries in manufacturing processes may have revolutionized an industry and made former equipment obsolete over night, or a steady program of improvement of one part after another may have brought about a more evolutionary change which, although more gradual in its effect, is none the less important and effective in keeping an industry abreast with progress. A new idea may therefore, have the effect of completely changing the methods and machinery used in a single industry, or it may contribute a somewhat minor change for the better, which can be used to advantage in a great number of industries, the end result being in the long run equal in importance to that first mentioned on account of its volume possibilities.

For about twenty years the fusion welding processes have been developed and perfected and extended far beyond the expectations

Fig. 2. Rim Welded to Web.

of the inventors of these processes, making the greatest headway at first as a means of repair work on broken metal parts, and more recently as production tools of enormous possibilities. It is the sentiment of the best informed engineers in the welding industry that the further extension of the use of welding lies in its application to production work, because while welding has come to be recognized as the universal first aid in metal failures, there are many operations in metal working industries which either have not been studied from a welding viewpoint or have not been accepted as logical welding jobs except by a few who have made scientific study of these operations. These exceptions are examples of the frequently noted fact that it is easy for com-

*Actual production cost, overhead not included, in factory having arc welding equipment available.

mercial usage of process to get years in advance of scientific research.

The general lack of fundamental design data for the application of fusion welding to the production of metal commodities has naturally prevented the rapid spread of its use in different industries where its application has proven occasionally successful, because engineers have so generally looked upon it merely as a substitute process for former methods of assembly, and have not been able to sense its advantages. However, when the production problem is studied as a whole, disregarding shapes, sizes and materials used with former methods, and specifying not only joint designs but also materials best adapted to welding assembly, then progress becomes more rapid. To use welding in place of riveting successfully, for example, does not mean figuring how much weld metal to deposit to take the place of each rivet, but how to design and construct the article so as to take advantage of the welded joint to the highest degree; in other words, to forget all about riveting and make the best possible welded structure.

This thought is a predominating one in the minds of welding engineers working on production problems, and is mentioned as a preliminary to the following discussion, because an important machinery unit furnishes the main topic and its fabrication as a welded article constitutes a radical departure from conventional practice. The product finally secured possesses all the essentials minus several of the disadvantages encountered in previous methods on construction. The specific example described and illustrated can be adapted to the production work in any plant where heavy machinery is made.

Fig. 3. Parts Required for Gear Shown in Fig. 1.

Among the more important advances made in the metal working industries in recent years is the substitution of welded steel for iron and steel castings in the manufacture of machinery. As a fundamental design evolution it has been the subject of considerable discussion and research. The general considerations favoring this improved construction are reduced cost, reduction in weight, increased strength and greater dependability of the finished product. The principles governing this application of the welding process, engineering data relative to comparative costs and strength, and the methods recommended for redesigning machinery parts for welding were outlined in detail in an article in the May, 1927, issue of *The Welding Engineer*. The specific application to be described below is the manufacture of heavy gear blanks from standard steel stock.

Welded steel gears have been used extensively in the plant of Dreis & Krump Manufacturing Company, a Chicago firm specializing in the manufacture of bending brakes and forming presses, and are manufactured in the plant as a part of the regular production process. The gears made by the process to be described are so satisfactory that the company has had many orders for gear blanks made by their process from other gear manufacturers.

Back of the development of this way of making their own gears is an interesting story of the growth of a large modern manufacturing establishment. The business had its beginning in the enterprice of its founder, Mr. Dreis, who made up sheet metal forming equipment for his own use years ago because none of the machinery on the market at that time suited his requirements. Men in non-competing lines became acquainted with his equipment and he received orders for duplicates. The business of making sheet metal working machines looked more and more promising as the demand for sheet metal products increased, and the present activity of Dreis and Krump is the result of a steady growth and expansion. Certainly a large measure of this growth is due to the early established policy of constantly seeking to improve manufacturing practice. They are now making their own gears by a new method because they were not satisfied with the gear blanks they were able to secure which were made by older methods.

Such a development, however, would probably not have been possible were it not for the fact that the executive personnel of the plant followed a policy of keeping pace with modern methods of metal working. Steel is used almost exclusively in the construction of the machinery produced by this firm, and early attention was given to the welding processes, both gas and electric, because of their great possibilities in fabrication. The welding in the plant is all under the supervision of a competent operator who draws upon all available sources for information that will be useful in the further application of welded joints. New welders, when needed, are trained in the plant in order to make certain that they are drilled from the start in the real fundamentals of fusion welding. Sound welds are the first consideration. The officials of the company are consequently satisfied with the results produced by the welding department, and ready with approval of new applications to the factory work. So welded steel gears seem more like normal development than a novelty, and stand as one out of numerous examples found in this plant of parts of equipment entirely redesigned by taking advantage of the welding process.

The reason for selecting this particular application is that it furnishes a distinct improvement in the finished product which to the user is more important than the cost consideration. Without discounting the importance of economical operation in production work, it is well to reflect that there are other considerations which may make redesign worth while. In this case the adoption of rolled steel gears came as a result of dissatisfaction with cast gear blanks. The heavy mahcinery which this plant turns out contains some fairly large gears, and the early practice was to purchase cast blanks from foundries, then finish them in the shop. Between sand holes and hard spots, the finishing process was a constant source of annoyance and extra expense. Large gears sometimes required as much as ten hours turning time on the lathe. Then it would sometimes happen that after cutting eighty or ninety teeth in a gear a bad flaw would turn up in one of the last two or three teeth.

This lack of uniformity in castings makes it necessary to design them larger and heavier than would be necessary if they could with certainty be made free from flaws, and the larger the castings, the larger the risers, and the more of them, adding another factor to the cost. A welded steel gear has the appearance of being more delicate than one made from a casting, and may be made much lighter without going below the necessary strength, and there is the added advantage of greater uniformity.

A still further advantage in the use of welded steel blanks is the elimination of patterns. This is of special importance in connection with the delivery of the finished gear to the assembly floor. When castings are used, special shapes and designs require special patterns, and the factory must wait for patterns to be sketched, made and approved before the casting can be begun. A welded gear, however, can be designed, cut from hot-rolled stock, welded and finished, in less time than it takes to make a pattern.

Exact cost comparisons on this work would be difficult to obtain, because no attempt has been made to get the cheapest possible product, and such comparisons might easily be misleading on account of the lack of standardization of welding operations in

different plants. A detailed description of the operations involved in the production of a welded steel gear blank will furnish sufficient basis for estimating costs in different organizations. It has been roughly estimated, however, that while there is practically no difference in the cost of welded blanks, compared with cast iron blanks, a noticeable saving is made on the cost of steel castings. This refers to standard sizes and shapes. When specials are required, the cost of castings goes up sharply, whereas no appreciable difference is made in the cost when the design of a standard welded blank is changed.

Another factor of interest to the designing engineer is the strength of the article. The qualities of mild rolled steel as compared to cast iron or cast steel are so well known as to make the answer to any question on this point obvious. In this factory the welded gears are made heavier and stronger than they need to be made to be equal in serviceability to a cast gear of the same diameter, because if they were dimensioned to the actual required strength customers would not trust them. This concession to the popular conception of strength as being represented by massive appearance is considered good manufacturing policy, although the plant engineers feel that their gears are much stronger than is necessary.

The remark has been made that in substituting welding for

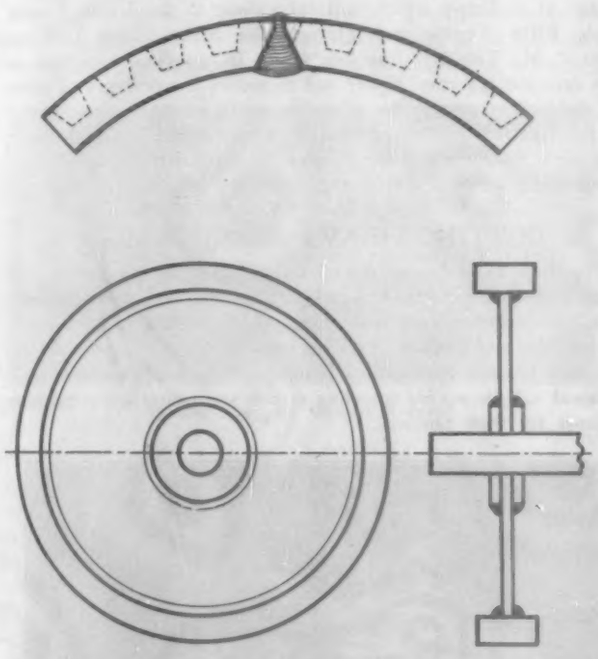


Fig. 4. Method of Cutting Teeth, and Section of Welded Assembly.

riveting the correct procedure is to forget all about riveting and redesign the assembly to make the best welded job that can be made. This principle has been followed in the design of welded gear blanks by Dreis and Krump. Castings, patterns, molds, risers, spokes, etc., were entirely forgotten, and attention was centered on the creation of a design which would make possible the production of blanks by welding together pieces cut from rolled steel stock.

After a study of the many possibilities a standard design was adopted which involves the use of four pieces of rolled steel for the production of a standard gear blank. The rim is formed from heavy bar stock. The spokes are replaced by a web disc, cut from steel plate. The hub is composed of two rings cut from rolled steel plate. The smallest gear regularly made in this manner has an outside diameter of eight inches, forty-eight teeth, six pitch, and 1¼-inch face. A brief time study was made to get an approximate figure on the time required to produce blanks for sixteen-inch and forty-five-inch gears. The total time required to make one blank for the sixteen-inch size is estimated at one and one-half hours. The blank is easy to turn, easy to cut, and uniformly dependable in quality throughout. The first operation is to cut from 1¼-inch by 2-inch hot rolled bar a length to give a ring sixteen inches outside diameter. This is given a radius on each end and then rolled to a circle in a special set of rolls. The high cost of having rolling done in outside shops led to the development of this equipment, which does a more perfect job at a fraction of the former cost. The ends of the rolled bar were beveled with a cutting torch so as to leave the point of the vee on the outside of the rim. An electric arc welder joins the two beveled ends, and the rim is ready.

The web of the sixteen-inch gear is made of quarter-inch plate. Ordinarily these discs are cut out on a punch press, as the plant is not equipped with a circle cutter and the press has proven to be a satisfactory method of cutting from a cost stand-

Fig. 5. 54-Inch Welded Steel Gear in Service.

point. The disc is tack welded inside the rim and then fillet welded all the way around on both sides.

Hubs for the regular sixteen-inch size are cut with the oxy-acetylene torch from 1¼-inch plate, then accurately centered and fillet welded against the web. It can be seen from the sketch of the cross section that the web extends from the inside of the rim to the outside of the shaft.

Another sketch has been prepared to illustrate an important part of the procedure in cutting the teeth. The cuts are always arranged to throw the weld between two teeth. This cuts out the bottom of the weld, the point where weak spots are most apt to be found, and makes sure of forming all the teeth from the original rolled stock.

Larger sized gears range up to forty-five inches diameter in regular production, although this size is frequently exceeded. The forty-five-inch size has 110 teeth, 2½ pitch, 4⅛-inch bore, 4¼-inch face (rim made of 2x4½-inch bar stock) and a web of one-half-inch plate. These are made up one at a time, while some advantage in time is gained in the smaller sizes by putting them through in pairs. Another point of difference in procedure is noted in the rolling of the rims. The smaller sizes can be radiused cold but the heavier rims have to be heated for this operation.

The time required for the individual operations is about as follows:

16-inch Gear

Cut, radius and roll tow rims	40 min.
Weld two rims	15 min.
Cut two plates for webs	20 min.
Weld webs in two rims	75 min.
Cut hubs for 2 gears (4 pieces)	20 min.
Weld hubs on 2 gears	20 min.

45-inch Gear

Hot radius rim	60 min.
Roll rim	40 min.
Bevel bar	10 min.
Weld rim	20 min.
Cut web	40 min.
Weld rim to web	2½ hrs.
Cut hub	30 min.
Weld hub	40 min.

These time figures do not represent any effort to cut production costs at the sacrifice of quality. The amount of welding could undoubtedly be cut down without reducing the strength below that required by a reasonable safety factor, but it is considered best to make all fillet welds continuous because of the solid appearance this gives to the finished job.

In service these gears are subjected to severe enough service to constitute a thoroughly satisfactory test for their strength. The large gear described above operates in conjunction with a 2,000 lb. flywheel, driven by a forty horse power motor at 750 r.p.m. The gear reduction is 21 to 1.

It is apparent from a brief inspection of the design that gear blanks could not be made of these materials and assembled satisfactorily by any process except welding. Mild steel being one of the easiest metals to weld by the metallic arc process, no

Fig. 6. Gear Guards Are Also Welded.

special precautions or tricks or procedure are required, of the operator. One point to be observed in a strength fillet weld, however, is to direct the arc so as to penetrate equally into both sections.

Because welding is understood in a fundamental way in this plant and practised intelligently, the management has been able to make for its own use a machine part better suited to its requirements than any that could be purchased from outside concerns. Furthermore, the advantages of the new type of construction are so marked that gear blanks made by this process are finding a ready sale in other plants where heavy duty gears are used in the assembly of various kinds of machines.

From this elemental step forward in the design of gears it is difficult to imagine how far progress can reach; welded construction may easily make possible the making of gears from inexpensive alloys giving greater strength than the steels now used, leading to reduced weight, reduced cutting cost, more compact design of machinery, and a total change in its appearance. The study of these possibilities should prove of absorbing interest to machine designers.

(Note: This is the third of a series of articles on Redesign Engineering, written especially for the Welding Engineer. The fourth will appear in an early issue.)

COMPRESSED GAS MANUFACTURERS' ASSOCIATION ANNUAL MEETING AT ABSECON, N. J.

The general meeting of the Compressed Gas Manufacturers' Association will be combined with the June meeting of the Executive Board, and will be held on June 16-18 at the Seaview Golf Club, Absecon, N. J. Through the courtesy of Mr. H. M. Hooker, all of the privileges of the club will be open to the association members. This includes the use of the golf course, tennis courts, swimming pool, and card rooms. The meeting will be given over chiefly to a discussion of how the association can best serve the industry. Mr. Elon H. Hooker and Mr. Herman Van Fleet have consented to lead the discussion.

FORMAL PRESENTATION OF MOREHEAD MEDALS FOR 1924 AND 1925

At the 1926 Annual Convention of the International Acetylene Association it was announced that the directors and officers of the Association had awarded the 1924 and 1925 Morehead medals to M. Edmond Fouche and Mr. Augustine Davis, respectively, for their pioneer work in the acetylene industry. The certificates accompanying the medals indicate that the award of the medal to Mr. Fouche is for his pioneer work in making possible the safe compression of acetylene into cylinders, and the perfection of oxy-acetylene blowpipes. The award of the 1925 medal to Mr. Davis is for his pioneer work in developing low and medium pressure acetylene generators and advancing the art of oxy-acetylene welding.

It has been decided that these medals are to be formally presented at a dinner which will take place at the Union League Club, Fifth Avenue and Thirty-Ninth Street, New York, at 7:30 P. M., Tuesday, June 1st, 1927. It is proposed to have on this occasion a formal dinner and to secure the presence of some of the leading men in the scientific world in general recognition of the fact that the award of a Morehead medal is a high honor and truly indicates that the persons receiving it have done something really worth while for the acetylene industry.

CUTTING HEAVY STEEL RISERS

The fact is becoming more and more apparent that modern steel foundry products, true to pattern and free from defects, owe their excellence in large degree to the cutting torch. Risers of any size and number, placed where they could be most effective, may be used by the steel foundryman without fear that their removal will tie up his traveling cranes and cause heavy machine expense for their removal.

Fly Wheel Casting. Note Huge Riser in Right Foreground.

A large steel company was offered a contract for casting ten steel flywheels in half sections, each half weighing 170,000 pounds, estimated, in the rough, and 122,000 pounds, finished. The weight of the half flywheel and the large section risers believed necessary to insure a sound metal throughout presented a serious obstacle to cutting the risers from the casting. It was impracticable to move the castings to a machine tool because of the great

size and heavy weight, and even had the facilities been available for moving them to and from a machine, no machine was available of sufficient power and capacity to cut off risers of the size considered necessary for the job. Upon receiving the assurance of the Industrial Engineering Department of the Air Reduction Sales Co. that the risers could be cut with the oxy-acetylene torch the contract was accepted and successfully carried through.

The diameter of the flywheels is 26 feet, with 29-inch face. The half sections were cast with four risers each, having a cross section 28 inches by 36 inches. The weight of each riser was estimated to be 8,500 pounds.

The risers were cut off at an average time of 17 minutes for one riser, the best cutting time being 14½ minutes for one riser, with an Airco-Davis-Bournonville cutting torch and Airco gases, using a No. 10, Style 81, cutting tip, working with an acetylene pressure of 15 pounds, and oxygen pressure, 150 pounds, at the torch.

The acetylene consumption per cut was 13 cubic feet and oxygen consumption 600 cubic feet. Cutting costs, including gases and labor, were less than ten dollars per riser.

GAS WELDED HOUSE HEATING SYSTEMS

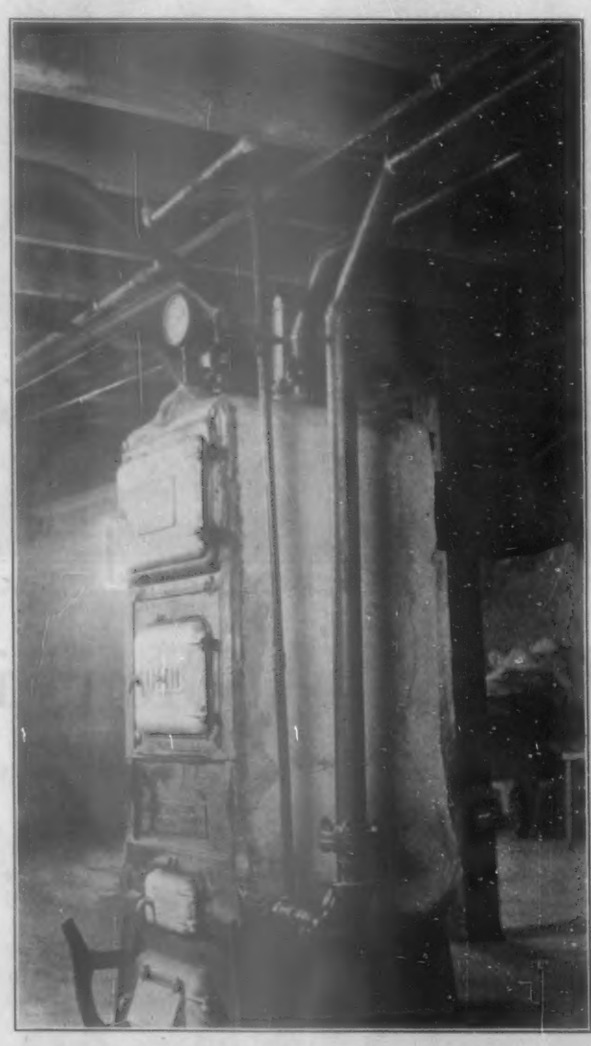
The number of connections made and the size of the pipe involved in the ordinary heating system for a small residence has for a long time been the cause of much doubt as to the actual economy involved in welding such systems instead of using pipe

Welded Tee and Welded Reducer.

fittings. A welder who was having a new home built decided to experiment with welded pipe in his own heating system and find out for himself whether money could actually be saved on such an installation. This decision was made after the complete heating plant including the pipe, radiators, gauges, fittings, and etc., had been delivered to his house, so when the job was over he had a chance to count the number of fittings which welding

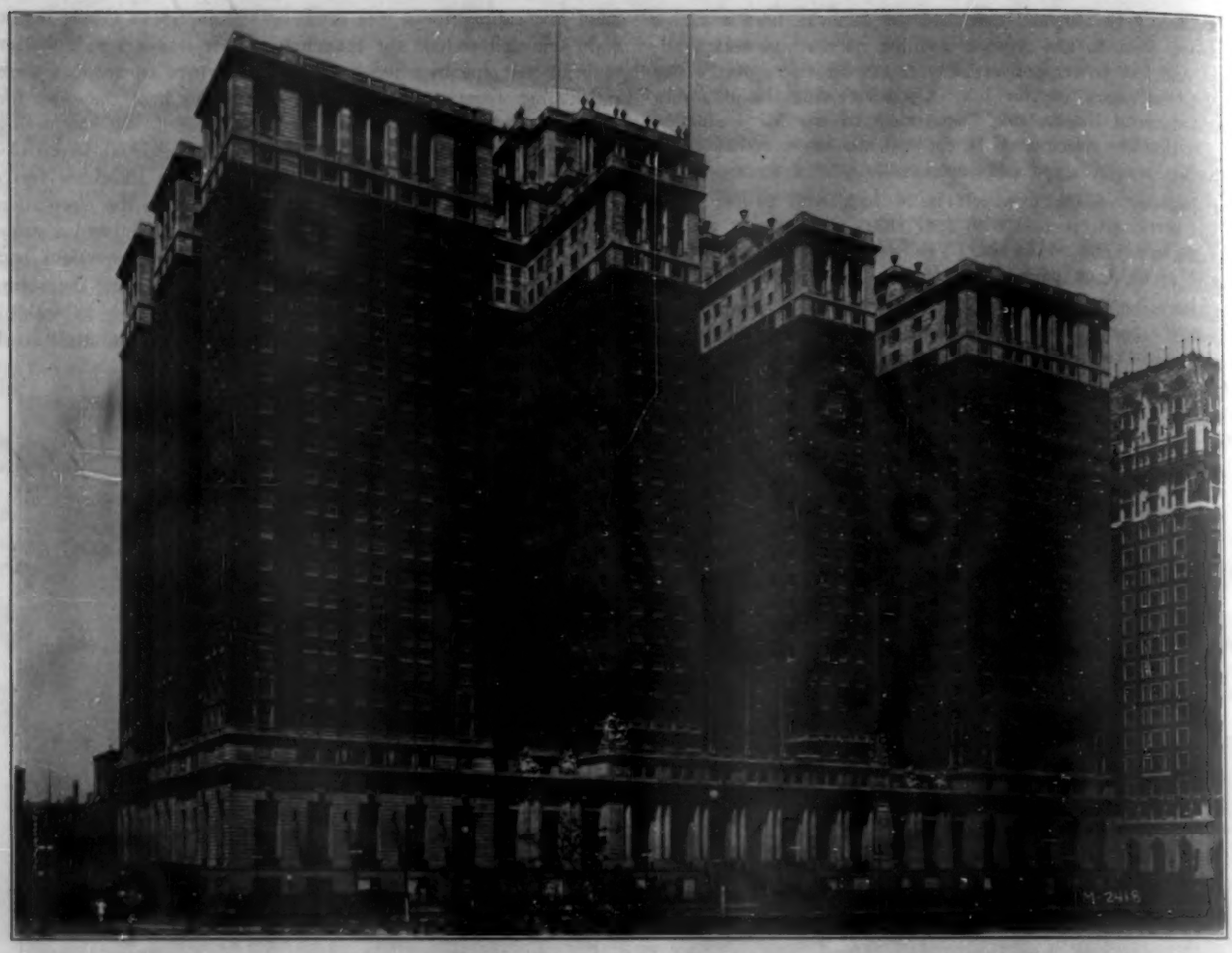
Variety of Joints Easily Handled by Welder.

made unnecessary. In following the manufacturer's layout for the installation of the hot water heating plant he made the following changes: wherever a 90° coupling was called for he either made a wide radius bend or welded in a relatively long section of pipe at 45° angles; wherever branches occurred from the main line calling for a Tee coupling he simply cut a hole in the main line and welded the branch to it. It was a simple matter to bend the pipe in a number of places where connections were called for, using the oxy-acetylene torch to heat the pipe for bending. Reducers were made by simply heating and hammering down the end of the larger pipe. The long gradual sweep obtained by making two welds at 45° angles as a substitute for a 90° coupling made a considerable improvement in the circulation of water through the system. After the job was finished a study of the original layout showed that 117 screwed connections had been eliminated and 53 assorted fittings thrown into the scrap pile as useless. This was accomplished by making 23 welded joints and bending the pipe at 34 places. The materials used



Long Easy Sweeps Obtained by Welding Main Water Line.

were about 50c worth of welding rod, 1 small tank of acetylene, and one 220 cubic ft. tank of oxygen, the total time including making connections to the boiler, cutting the pipe, welding the pipe, setting up the radiators, etc., was 33 hours. A comparison of the cost of installing the heating system in this way with the estimate given by a contractor who planned to use the fittings showed a considerable saving in the installation work alone. This saving could be considerably increased if plans were made in the first place to use welding and the heating system ordered from the manufacturer minus the fittings. The experience of this welder indicates that even on small pipe installations welded lines have the advantage not only of costing less but also of giving a better job.



The World's Largest Hotel, The Stevens, on Chicago's Lake Front, Used Welding Extensively in Building Its Modern Kitchens.

Welded Kitchens in the New Stevens

Seamless Construction in Kitchens of This Famous New Hotel Reflects Care of Management to Secure Durability and Perfect Cleanliness

IT IS in the kitchen that a hotel's reputation—and profits—are made or lost. To a hotel operator, the kitchens always afford a great deal of material for study—how they are arranged, how equipped and how operated. No detail is overlooked in the designing of this vital department. So it is not surprising that in planning the equipment for the new Stevens Hotel, which rises impressively above Chicago's Michigan Boulevard, some of the best engineering experience and skill in this field was called upon to make these kitchens the finest in the world in every particular.

Through the courtesy of the Hotel World and of Albert Pick & Company, the Welding Engineer has secured these photographs of the Stevens kitchens and also the shop views from the great plant of Albert Pick's at Chicago, where the equipment was manufactured. Before inspecting the kitchens, it will pay us to consider first the interesting results that have been accomplished with welding in the Pick plant, where the research for new methods and new uses for welding is going on continuously. As an engineer in charge of equipment production remarked significantly, "Even though Pick's restaurant and hotel equipment is known the world over, we know that we must always be alert for a chance to improve our product in material or design in order to hold our lead. And in this welding has been a big factor."

It has naturally required much experimentation to adapt for welding equipment which had always been made up of castings or of steel shapes riveted and bolted. Today, however, the framework for practically every item, from a small truck to steam tables and range bodies, is welded.

One of the most interesting examples of what has been accomplished in this plant is the gas welding of monel metal, great quantities of which are used in the construction or exterior finishing of much of the equipment. The new design of coffee urn, for instance, calls for shapes which could not be made by pressing. These parts are easily made up, however, by pressing the curved pieces out of monel metal and then welding them together with the torch. After finishing to a high polish, no trace of a joint is visible. This construction has made it possible to employ principles of operation which have added to the efficiency of the urn.

Much monel metal is also used in the trimming and finishing of steamers, lunch and cafeteria counters, cook's tables, shelving, and sinks. For the various purposes, monel metal sheets of 8 to 26 gauge are being successfully welded.

In the assembling of the framework for counters, shelves, and the like, and in the construction of range bodies, and of the steamers, which are built of boiler plate, metallic arc welding is used.

The steamer used for cooking vegetables by steam, has been completely redesigned in order to take advantage of welding. It was formerly made up of three heavy iron castings, which were assembled on the job. Aside from the extra labor and material costs involved, much difficulty was experienced with faulty castings. These troubles have been entirely done away with by changing the construction to welded boiler plate, the whole

Fig. 1. Warming Tables in Main Kitchen.

steamer, complete with fittings, being assembled in the shop. The design shown in the group of shop photographs has recently been still further refined to improve efficiency and appearance with a reduction in manufacturing cost. One important change has been the reduction of the number of fittings from 60 to 28, all welded together. The entire body is now made of eighteen pieces, including the shell, legs and all partitions. And there is no longer the problem of replacements on account of faulty materials.

Everyone who had a part in the design of equipment for the Stevens kitchens showed this same willingness to discard old patterns, materials, and methods of assembly wherever they did not meet requirements. The kitchens were all planned by Mr. Ernest

Fig. 2. A Part of Special Banquet Service Kitchen.

J. Stevens himself. With many years experience at the Hotel LaSalle, and with its kitchens as an experimental proving ground, Mr. Stevens developed his own ideas of kitchen planning. He questioned experts in the field until he had added final details to his own sum of knowledge. Two recognized authorities were in constant touch with the work: Mr. F. B. Long of Holabird and Roche (the architects) and Mr. S. V. Wells of Albert Pick & Company.

Passing through the Stevens kitchens, one is more and more impressed with the fact that Mr. Stevens has not permitted precedent to rule him when he felt that new paths should be made. He has devised new methods of operating and has planned special equipment to meet unusual conditions. In the light of all this, it is significant that welding has been called upon to such a large

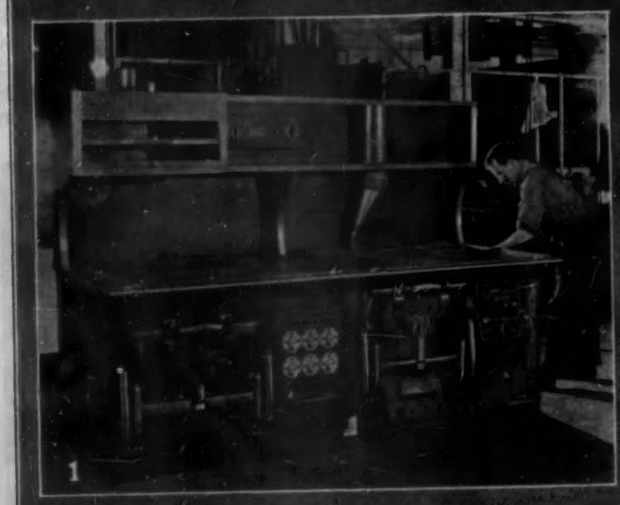
Fig. 3. Kitchen of Japanese Lunch Room.

extent to produce the utmost in efficiency, durability, sanitation, and economy of operation.

There are in all five kitchens, and each bears the mark of individuality and is fitted with equipment of the highest calibre. In the Main Kitchen alone there are eighteen welded ranges,

Fig. 4. Welded Shelving in Banquet Kitchen.

providing 220 square feet of cooking surface. There are eight large broilers and eight salamanders, and a specially designed grill oven in which squabs, breasts of chicken, etc., for an entire banquet can be prepared in one operation. Then there are the insulated warmers for plates, silver, and rolls; the steamers for preparing vegetables; the dishwashing equipment, service pantries, and a long warming counter where hot courses, prepared some-



1. Range Body of Welded Steel.
2. Coffee Urns of Monel Metal.
3. View of Assembling Shop.

4. Steamers for Cooking Vegetables.
5. Welding Steamer Bodies of Boiler Plate.
6. Display of Welded Restaurant Equipment.

Views in the Plant of the Albert Pick Company, Chicago.

what in advance, can be kept warm on the shelves and easily removed by the waiters. At the far end of the hot service counter is a battery of five coffee urns. On another floor are the ice cream department, the confectioners' room and the bakery.

Fig. 5. Dishwashing Section.

All the equipment is gleaming and bright. And it will be that way forever, for it is made of monel metal that is permanently stainless and rustproof, with all of the brilliance of the nickel silver which is one of its component parts. This metal is one

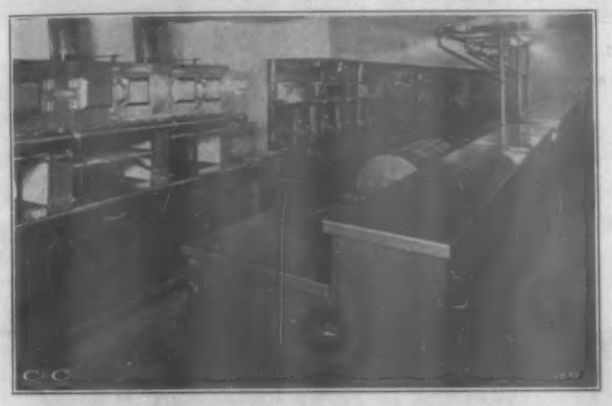


Fig. 6. Range and Broiler Section of Cafe Kitchen.

of science's greatest contribution to departments of food preparation, since it is an assurance of utmost cleanliness.

And there are no joints, seams, or cracks in which water and food can collect, to contaminate other food and to shorten to life of the equipment, for every seam is welded.

APPLICATION OF WELDING TO A STEEL STRUCTURE

Considerable interest has centered on the all-welded five-story shop building recently erected at Sharon, Pa., for the Westinghouse Electric and Mfg. Co., since it is probably the outstanding example up to the present time of welded building construction.

The following extracts from a paper presented by Mr. J. H. Edwards, vice-president of American Bridge Co., at the meeting of the American Iron and Steel, Institute at New York on May 20 will be of interest to those who have been following the work done in this field.

"By comparing the actual costs of this welded structure with what a rivet one might be expected to cost, we find that there was a saving in material, due to design, of about 95 tons, or 11 per cent; the template making was a trifle less for welded; the shearing, marking, punching and finishing would be about 10 per cent less for welded, the assembling of parts for welding about 100 per cent more for welded, and the welding in the shop, not including the use of electrical equipment, shows a cost four times that of shop riveting. The raising of steel in the field, due to extra guying for alinement, was increased about 10 per cent, and the field welding cost, not including the installation and use of electrical equipment, current and training of welders, was about the same as the riveting would cost. Prevailing shop and field labor rates were paid. Standard overhead expenses are included in the costs. After deducting the cost of training welders and making due allowance for other items that were included in this first job, and would disappear if shop were organized for welding, the additional cost of welded structure would be about $10 per ton, or about $8,000. The material saved by welded design was 95 tons at a cost of about $3,800, showing an excess cost of $4,200 over a riveted structure, not including use and maintenance of electrical equipment, welding wire and cost of training school, all furnished by the Westinghouse company.

"Estimates based on unit costs determined on this work, indicate that the continuity feature of the design as a whole cost more than the material saved, besides introducing into the design and fabrication some complicated and possibly undesirable features. Continuous or fixed end support members have their place in structures, but before being used to any great extent all engineering and cost features should be carefully weighed.

"Based on the experience gained from this work it would seem that the all-welded skeleton structure is not the most economic one. It is possible that some parts of such a structure might be welded to advantage.

"By the fusion welding process joints can be made as strong as the base metal, and the full gross section of a tension member can be used, with no deduction for holes as when rivets are used. Due to the greater stiffness of end connections, and the ease with which component parts can be more rigidly held together, welded details of compression members increase their efficiency. By taking advantage of these favorable factors, and with the added advantage that will obtain when sections more suited to welding are rolled, there may be some saving in material that will more than offset the extra cost of welding.

"Where existing structures require strengthening because of increased loading, material can be added more advantageously by welding than by the expensive method of drilling holes and driving rivets in awkward field positions; also when additions are made to structures, welded connections can be well and cheaply made with a minimum disturbance of walls and exposure of occupants. Furthermore, in favor of welding there are other considerations that might be given some weight aside from economy, such as the elimination of noise of riveting in thickly settled communities; another somewhat connected factor is the possibility of making welded connections, for resisting lateral forces such as wind, much simpler than the present cumbersome riveted brackets that interfere with the architectural treatment of exterior wall and interior finish. Welding can be used to supplement riveting and will eventually find its economical place.

"Designers and fabricators of structural steel from many years of experience have learned the virtues and weaknesses of rivets and know how to use them to make safe and economical structures. They are now seeking the fundamental facts concerning the welding art on which they can base their determination of strength. It is generally accepted by those who have had any structural steel welding experience that safe and reliable welds can be made by a trained operator following a well designed procedure control. There is a demand for standard specifications and methods of making welds by the different processes. Values on some unit bases for the strength of welds of different types should be fixed. Some reliable way of controlling the mechanical and personal element used in making welds, and in testing the completed work, should be established. With these factors fixed by scientific research and made available to the industry, the manufacturers of welding apparatus, the advocates of welding as a method of joining steel parts, and the fabricators of structural steel, all cooperating to solve an engineering and economic problem, will doubtless make great progress in the development of the art of welding in the structural steel industry."

MICROSCOPE SHOWS CHARACTER OF SPOT WELD

The successful use of spot welding in hundreds of industrial plants has demonstrated the unquestioned practical value of the process. The good service given by spot welded articles has been evidence enough from many manufacturers who are using spot welding machinery every day in production. But when the volume of spot welding operations reaches such proportions as to require the use of hundreds of machines in a single plant, it is advisable to make the most intimate study of the nature of the work done by the equipment.

No such investigation is complete without the use of the microscope, an instrument that leads to an extremely complicated study, but tells the skillful metallurgist facts about the structure of the weld which can be determined in no other way. J. W. Meadowcroft, Superintendent of the Edward G. Budd Manufacturing Company, Philadelphia, recently forwarded the half dozen microphotographs shown here, which formed part of the program of investigation of the microstructure of spot welds in sheet steel. The first three photographs show the same section of a spot weld at 50, 100 and 500 diameters, respectively. Note how the large crystal at the junction of the spot weld shows up at the larger magnification. The photographs taken at a magnification of 50 diameters shows the grain in this area to be columnar in form, resembling dendritic grain, but the structure has not been determined to be really dendrites. Furthermore, it has been shown by experience, that as far as strength is concerned the spot weld is perfectly satisfactory on sheet steel work.

The last three photographs show the same area as is shown in the first three photographs and at the same magnification, the difference being that the metal was annealed with the oxy-acetylene torch before taking these photographs. It is not customary nor is it considered at all necessary to anneal spot welds in general practice. It was done in this case for illustrative purposes only. By reference to this set of photographs it is possible to get a much better idea of the location of the area under examination. What appears to be a dark line at the left near the center of each of these photographs is the line of separation, between the sheets welded. The welded area is at the right of the end of this line in each photograph. As the magnification becomes higher it becomes increasingly easier to note the good union of the metal in the parts actually welded. The grain marked with a cross in the last photograph, which it will be remembered, was taken at a magnification of 500 diameters, shows the perfect union between the metal.

Mr. Joseph Winlock, metallurgist for Edward C. Budd Manufacturing Co., points out that a good union of the metal and a weld free from inclusions as illustrated above, is easily obtained if the surfaces of the steel are kept clean, that is, free from scale and dirt, before welding.

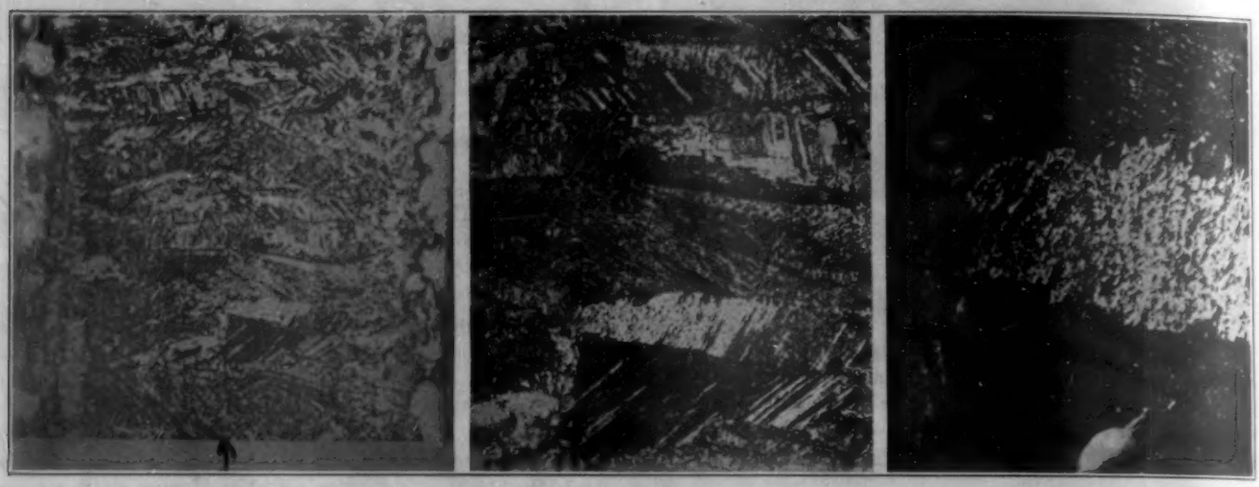


Fig. 1. Fig. 2. Fig. 3.

Spot Weld at 50, 100 and 500 Diameters.

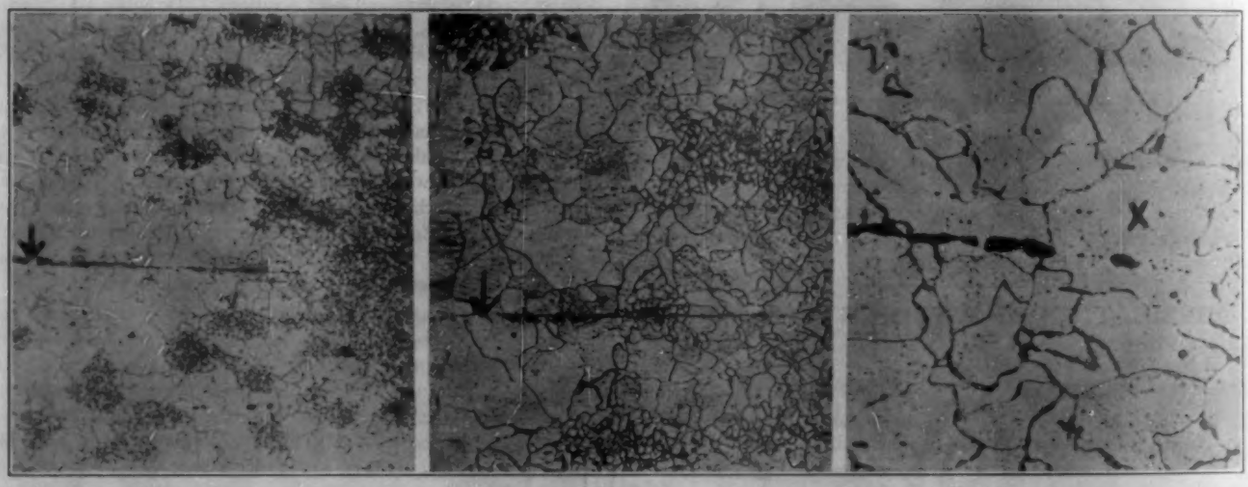


Fig. 4. Fig. 5. Fig. 6.

Same Section After Annealing with Gas Torch.

R. K. RANDALL HEADS CLEVELAND WELDING SCHOOL

R. K. Randall, formerly head of the Y. M. C. A. technical trade school in partnership with E. T. Scott has organized the Cleveland Welding School, which opened last month at 2094 E.

R. K. Randall.

19th St., Cleveland, Ohio. The new school is devoted to the instruction of both gas and electric welders and conducts both day and night classes. It occupies 2,500 feet of floor space and at the present time has the following equipment: two electric arc machines, sixteen oxy-acetylene welding outfits, one carbo-hydrogen cutting outfit, and three oxy-acetylene cutting outfits.

The New Cleveland Welding School.

Half a dozen different makes of torches are represented in the installation, as the proprietors consider it desirable to have the operators familiar with more than one make of torch. Nineteen students have already been enrolled and both day and night classes are operating. A cordial invitation has been extended to members of the welding industry to make the school their headquarters when visiting Cleveland.

WELDING ON BRIDGE CAISSONS

D. A. Clements, of the St. Louis office of the Gibb Welding Machine Co., recently forwarded these interesting photographs of a rivetted and welded bridge caisson. There are 450 feet of

View of Interior of Caisson.

overhead welding and 600 ft. of flat welding on this job. The large pipe shown is welded and a ladder is welded inside for the men to use. The machines used on the job were A. C. 200 ampere type made by the Gibb Welding Machine Co.

When the caissons were finished the water in the Mississippi river raised 6 ft. and the caissons were ready to float down the

Arrival of Caisson at Pier No. 3.

river. Two Ford tractors and two welding machines were under water for 48 hours.

Mr. H. G. Pod, vice-president of St. Louis Structural Steel Co., was the designer of these caissons. Mr. H. G. Moore, general superintendent, had charge of all shop work. The caissons were so large they had to be built on the river bank.

The speed of welding was 9½ ft. per hour overhead and 20 ft. per hour flat. In testing the caissons, they were filled with water, and no leaks were found in the overhead work, but several showed up in the flat work. The caissons shown are being used on the Cape Girardeau job, and caissons for several other bridges are being completed.

LONG SHUTDOWN AVOIDED BY WELDING

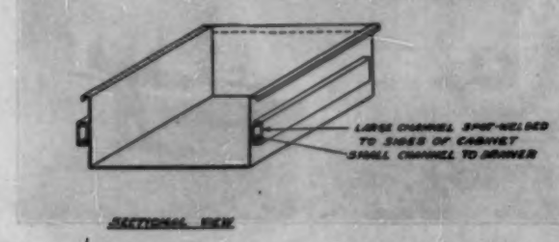
Examples of great savings in time and repair costs through the application of welding are becoming so numerous that they can hardly be called welding news, unless there is some new problem presented and solved.

A year ago an attempt was made to weld a crack in a large casting containing the valve deck of a triple hydraulic pump operating the elevators of a Chicago skyscraper. The leakage had become dangerous and the crack was growing with the pressure alternating from 20 lb. to 200 lb. thirty times a minute, the crack seemed to develop a breathing action which accelerated its growth. To remove the massive casting would have necessitated widening doors and tearing out partitions, and would have caused a shutdown of about three months. The whole job, including cost of casting and installation, and expense of shutdown, would have meant an expenditure of at least $3,800.

It was decided to weld by veeing out the crack and building up flush with the face of the casting. The weld was extended as far as the crack appeared, and the pump was put in service. After several months it was found that the crack was still spreading from both ends of the weld, although the weld itself was holding. To further reinforce that section of the casting, it was drilled and tapped for eighty-four studs, which were cut off at a height of half an inch, and a patch built up over the studs, eight inches wide and four feet long, extending over the old weld and at least six inches beyond the probable limits of the crack. The contraction between the studs holds the crack tight and is preventing its further spread.

WELDING METAL FURNITURE FOR STRENGTH

The Frank S. Betz Company of Hammond, Indiana, has been recognized as builders of the finest steel furniture for more than a quarter of a century. The beauty and convenience of design, the strength of construction, and their sanitary advantages have made their products standard hospital and surgical equipment throughout the country. In their big modern plant experienced workmen following the most approved factory methods are working together to maintain the reputation for high quality of the products of the plant. The sheet metal products manufactured here are made of high gauge furniture steel scientifically prepared, pressed and welded into a single unit that is practically indestructible and will give a life time of service. The great sheets of heavy steel bought to rigid specifications, are shaped and formed on mammoth presses. The pieces are then welded together so as to produce indestructible units without joints or seams to


LARGE CHANNEL SPOT-WELDED TO SIDES OF CABINET
SMALL CHANNEL TO DRAWER
SECTIONAL VIEW
STANDARD DRAWER CONSTRUCTION WITH CHANNEL SUSPENSION

Spot Welded Channels Improve Drawer Construction.

open up or pull apart. One of the designs used extensively in this plant is illustrated in the accompanying sketch. This shows the drawer construction. A small stout channel is welded to the drawer and a larger channel is welded to the cabinet frame. The smaller channel slides easily in the large channel without the binding or noise so often found in furniture made with the drawers merely framed in. The suspension type of draw construction is similar to that used in the better grade filing devices. The sketch indicates that this type of drawer construction is made possible by spot welding machinery which makes a permanent connection between the channel and the drawer or frame in an instant's time. Two large Federal spot welders are constantly on duty in this plant, illustrating not only the great variety of work which may be accomplished by spot welding in any sheet metal working establishment, but also the fact that the presence of the spot welding machinery in the factory makes possible a greater variety in design. The spot welder in skillful hands is used to weld panels to frames and also to weld in strips of fluxing metal to seal corners and joints, making them dust-proof. Other uses are welding sheet steel to angles, tubes, and fastening sides, top, bottom and panels to frames, and spot welding corners. The result is a product which they are able to guarantee for strength and enduring qualities.

STEEL FOR BALL ROOM OF APARTMENT HOTEL ERECTED BY WELDING

Steel for a new ball room (2,850 sq. ft.) on the roof of the fashionable Alcazar Hotel in Cleveland, Ohio, was erected without the driving of a single rivet. Accompanying illustrations show the apartment hotel and the arc welding operator at work on the columns.

The use of welding for the erection was decided on for two reasons. First—Connecting on the new addition to the old welding could be done with a minimum disturbance to existing walls,

Above—Alcazar Hotel.
Below—Welding Column of Ball Room.

etc. Second—Lack of noise of riveting was highly desirable.

Considerable discussion has been going on among structural engineers regarding the possible economies of welded construction as compared with riveted construction. In many cases, these discussions fail to touch on the question of how much it costs to create a deafening racket with riveting guns. No one, of course, knows exactly what it costs. Mr. Robert Wharburton, manager of the Alcazar, says that disturbance of his guests costs too much at any figure. Much the same attitude is taken by many hotel managers who have suffered loss of good will for their hostelries due to the erection of steel structures in the vicinity. Hotel guests can find quiet surroundings in other hotels. The case of hospital additions, while not exactly similar, involves the same question. Hospital guests cannot, in many cases, check out and go to another hospital. The patient who has just had his appendix out has little appreciation of the music made by three or four riveting guns being operated just outside his window.

The value of noiseless erection of buildings by welding is shown by the fact that the Health Department of New York City is making a serious study of the process in order to eliminate the noise of the riveting guns as a health measure.

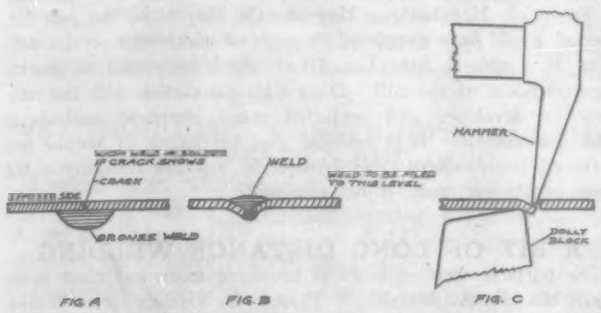
Work on the Alcazar was done by the National Iron and Wire Company, Cleveland, Ohio. Paul Ockert, Cleveland, was the architect. Lincoln arc welding machines were used.

FENDER WELDING WITH BRONZE

By F. Novak

There has been little said about auto body and fender welding and in my visits to various job shops I have observed that most of the work done in this line is very crude. That is, little attention is paid to the appearance of the finished job. It has been my experience that a perfect job brings high prices in return for the work.

Of course, we have to do considerable work where price is the only consideration. This is done with steel rod as a rule. The majority of the work and the most profitable is almost invariably done with bronze, welded from the reverse or bottom side. This requires less finishing and also permits reinforcing, which is sometimes advisable on fenders. Where it is impossible to weld from the reverse side, a serviceable and undetectable job can be done as in Figure B in the sketch.



Applying Bronze to Broken Fenders.

My reasons for using bronze in place of steel are as follows: Bronze stands vibration better, files easier, causes less distortion of parent metal, and last but not least, it does not damage a Vixen file. This one item is a very important factor.

Where pieces of a fender or panel are missing, or in case that they are too badly torn, sections of new sheet can be welded in and shaped, bumped and filed, and if properly done it will be impossible to detect from the outside. But this is a job that requires considerable skill in sheet metal working.

In long seams, tack weld first at intervals of about three inches. If the sheets warp out of line, stop and shape them again, even if you have to do this for each tack weld, as considerable time is saved if you start the job right This is true of finishing the weld also and very important.

PACIFIC NORTHWEST HAS WELDERS' ORGANIZATION

Welders, as well as helpers and students of welding, will doubtless be interested in an operators' organization which has been functioning for some time in the Pacific Northwest. As there did not seem to be any organization which offered exactly what the welders of this district were looking for, they got together some two or three years ago and formed the "Associated Welders and Helpers," to meet the need of an organization of and for welders and cutters and devoted particularly to their needs and services. The officers and members of this association feel that a high degree of success has been met in achieving the primary object of the association, namely, to establish an organization where they could get together in harmony and co-operation, discuss their mutual problems and work for their mutual benefit and the advancement of the welding industry.

Advancement through education is stressed. Trade topics are taken up and discussed at meetings, the members freely and frankly exchanging welding "tips" and information. A very successful employment service is rendered, valuable alike to welders and employers, as every effort is made to send out only competent welders. A library of welding literature and latest welding magazines is maintained. It is hoped soon to establish an apprenticeship system whereby student welders can be thoroughly trained and their ability made sure of before they are turned loose on the trade as competent welders.

The officers are all practical, working welders, employed at the trade. Acetylene welders, arc welders, acetylene cutters, thermit welders and other skilled workmen of the welding trades are eligible to membership. Helpers or students may join as "Helper." The home office of the association is at Bremerton, Wash.

RIDES IN WELDED BUS

Here is a wee lass who thinks welding is the greatest invention of all time, for a welder waved his magic rod over a scrap pile and produced the most serviceable baby carriage in town.

A Booster for Welding.

The baby's buggy was made by taking the wheels of a kiddy-car and an old fashioned baby carriage, cutting them apart, then re-assembling with odds and ends pieces of steel to make a very modern four-wheel push cart.

WELDING LARGE PIPE BENDS FOR EUROPEAN HYDRO-ELECTRIC PLANTS

By A. C. Blackall

Welding has been adopted in place of riveting in the case of piping and other parts in a great many of the hydro-electric plants now under construction in Europe. A notable example of this tendency is the welding by the electric process and quasi-arc electrodes of the four casings, each 22 feet across and built of ⅛-inch plate, for a hydro-electric installation in Scotland.

No less interesting and notable is the welding by the autogenous process of a pipe bend with an internal diameter of 6 feet, a total height of 14 feet 10 inches, and a length at the base of 22 feet. The plate of which it is constructed is 11-inch thick. This bend, which is the largest yet welded, was built in the Sulzer workshops for the works on the Jogne at Broc, belonging to the Entreprises Electriques Fribourgeoises. The chief difficulty was found to be not so much the actual welding of the twelve cylinders of 11-inch to make a perfectly strong bend; it was also found necessary to allow for deformations due to expansion and contraction arising in the course of the work. According to the drawings the distance between the two openings of the bend should have been as exactly as possible 16 feet, the difference from the specified dimension when the welding was finished was 11-inch, or an amount equal to the thickness of the plate. The working pressure to which this bend is subjected is 170 lbs. per square inch,

and it was tested to 260 lbs. first at the works and then when erected on the site, the welded joints being at the same time hammered. The total weight of the bend is about 8 tons.

ECONOMIC ADVANTAGES IN WELDING POWER SHOVEL PARTS

The application of arc welding to the construction of power shovels gives promise, according to actual tests in service, of savings which extend beyond economies in production. An entry for the Lincoln arc welding prizes for 1927, published in the Iron Trade Review, describes the results of actually constructing a power shovel without the use of rivets. Labor is an important item in the initial cost of the shovel, and by substituting one welder in place of the usual three men for layout, drill, and rivet a substantial saving was effected on this item alone.

Fewer parts by 45 per cent are used in the welded construction, with an accompanying saving of 20 per cent in weight of material. Altogether, there resulted a reduction of 25 per cent in the initial cost to the user. The operating costs of these shovels is less than if welded steel construction had not been used, due to the lower initial cost, lower deperciation rate, reduced weight, and fewer number of failures in service.

After predicting that its lowered cost will permit a wider use of the power shovel, the entrant estimates that, on the basis of 15,000 power shovels in operation in the country at this time, and with an average saving in operating cost of $300 per year, the annual saving would amount to $4,500,000. And with a production of 2500 shovels a year, and an average saving of $500 in initial cost, a further saving to the country of $1,250,000 would be effected. Whether these figures prove to be over-optimistic or conservative, the savings in production and operating costs through the adoption of welded construction will certainly more than justify the application of this principle in power shovel design.

G. P. A. CONVENTION INCLUDES INTERESTING INSPECTION TRIPS

The 13th Mid-Summer meeting of the Gas Products Association will be held in Montreal July 13, 14, and 15.

The Chicago and Western members of the Association will leave Chicago by special sleepers Monday, July 11, arriving in Montreal Tuesday evening.

The convention will be held at the Mount Royal Hotel and the technical sessions will occupy the greater part of July 13, 14 and 15.

On Thursday afternoon, July 14, the convention will visit the Angus Shops of the Canadian Pacific Railroad at Montreal and a golf tournament will also be held at one of the Montreal golf courses. Several sight seeing trips have been arranged for the ladies who attend the convention and there will also be one afternoon devoted to Bridge.

On Friday evening, July 15, the convention will leave Montreal by special sleepers for Shawinigan Falls, where on Saturday, July 16, the members will go through the carbide plant of the Shawinigan Products Corporation and the power plant of the Shawinigan Power Company, both located at Shawinigan Falls. The party will return to Montreal Saturday afternoon and will disperse from that point, Eastern members leaving direct for New York and other points and Chicago and Western members via the Canadian Pacific Railroad for Chicago and other points West.

This will be an exceedingly interesting and instructive convention. A very fine program has been arranged with a number of interesting papers upon subjects relating particularly to the gas welding industry. The Mayor of Montreal will deliver an address of welcome to the Association at its first session. The recently completed Gas Products Association's film will be exhibited and there will be many other interesting features.

OBITUARY

P. William Kromer, Buffalo district manager, Air Reduction Sales Co., died on May 21st, after an illness of five weeks. Mr. Kromer had been associated with the oxy-acetylene industry for nearly twenty years, of which eleven years were with the Air Reduction Sales Co. Previously he was local manager of the Niagara Oxygen Company, and had also been connected with the Searchlight Company and other producers of gases, and had been manager of a job welding shop in Binghamton, N. Y.

Mr. Kromer was a member of Buffalo Consistory, Ancient Accepted Scottish Rite, Ismailia Temple, Occidental Lodge 766, F. & A. M., Mystic Circle Lodge 520, the Buffalo Rotary Club, the Greater Buffalo Advertising Club, the Buffalo Chamber of Commerce, the Buffalo Athletic Club, the Central Railway Club, the American Welding Society, the Erie Downs Golf and Country Club, and the West Side Business Men's Association.

Mr. Kromer is survived by his widow, Mrs. Grace L. Hogg Kromer, and his son, Norman W. Kromer. The funeral was held May 24 at the family home, 505 Breckenridge street, under the auspices of Occidental Lodge.

Wm. B. Scaife & Sons Co., of Oakmont, Pa., manufacturers of range boilers, pressure tanks and water softening apparatus, announce with regret the death of their superintendent, G. A. Meckel. Mr. Meckel died suddenly at the home of his daughter in Frederick, Maryland, on May 16. On May 26 of this year Mr. Meckel would have completed 64 years of continuous service with Wm. B. Scaife & Sons Co., 51 of which he served as general superintendent of the mill. During his association with the company he developed and perfected many improved methods in tank construction. It is believed that his length of service sets a record for continuous employment by any one company in the State of Pennsylvania, if not nationally.

A BIT OF LONG DISTANCE WELDING

The portable welding outfit is becoming more important every day. Mr. F. A. Marsh, of Paxton & Vierling Iron Works, Omaha, Nebr., mentions in a letter that a few weeks ago they loaded their Westinghouse welder on a Ford one-ton truck, sent it with the operator to Lincoln, 68 miles away, welded 120 lineal feet of seam in connection with the steel work for the passenger station of the Burlington, which the firm is erecting in Lincoln. This job took the most of two days' time, including unloading, connecting, and reloading the welder, which was returned by truck to Omaha when the job was finished.

GENERATOR BEARING BRACKETS FOR CONOWINGO ARE ADC-WELDED

Arc-welding has recently been adopted by the Westinghouse Electric & Mfg. Co. to the construction of parts of the generators for the Conowingo, Maryland, hydro-electric project. The lower bearing bracket, which alone weighs 16,000 lbs., and will support one of the 40,000 Kva. generators, is a cross-shaped structure 24.9 feet wide and long, with a 68 in. opening in the center for the shaft. The bracket is built up of 24 in. standard girders with all joints arc welded. The heavy cast steel brackets about the center opening are also welded, round holes being cut in them for greater welding periphery.

J. F. LINCOLN SPEAKS ON WELDING AS PRODUCTION PROCESS

At the Spring Meeting of the American Society of Mechanical Engineers at White Sulphur Springs, W. Va., Mr. J. F. Lincoln, vice-president of the Lincoln Electric Co., gave a very interesting and instructive paper on the advantages of arc-welded steel parts over those of cast iron on riveted construction. Mr. Lincoln dwelt at length on the savings in cost effected by replacing iron castings with arc-welded steel parts. He also discussed the inconsistency of permitting arc welding in superheaters and steam piping and forbidding it in boilers, calling attention to the

fact that "locomotive boilers on which there has been considerable welding both in manufacture and repair, carrying 200 lbs. pressure, and hand fired, are racked over the rails at sixty miles an hour. Very few cases of weld failures have occurred. Yet if one of these locomotive boilers is put on a brick foundation, automatic stoker fed, and run at 16 lb. pressure, its owner will be put in jail."

MORE RESERVATIONS FOR STEEL AND MACHINE TOOL EXPOSITION

The National Steel and Machine Tool Exposition to be held in Detroit the week of September 19, under the auspices of the American Society for Steel Treating, demonstrates at this early date that it will be larger than any of the eight previous shows. Over 80,000 square feet have been reserved to date by 262 exhibitors. Among those who have made reservations since the announcement in the last issue are:

Central Steel & Wire Co., Keith Dunham Co., Krembs & Co., Alexander Milburn Co., Rail Joint Co., Weldit Acetylene Co., Allan Mfg. Co., Electric Arc Cutting & Welding Co.

Approximately 10,000 square feet will be devoted to an exhibit of welding material and equipment. This is a new feature of the Exposition, a certain part of the Convention hall being set aside for this line of equipment. The American Welding Society will hold its annual fall meeting at Detroit the same week of the Exposition, and in place of having an individual exhibition as in former years, will have it combined with the National Steel and Machine Tool Exposition.

WESTINGHOUSE CONSTRUCTS ANOTHER ARC WELDED BUILDING

Erection of the fifth arc-welded building in the group of the Westinghouse Electric and Manufacturing Company has been started at Derry, Pa., by the Jones & Laughlin Steel Company, to whom the contract was recently awarded.

The building, one of the few so far to be erected by the "noiseless system," will be a one-story mill type structure, 460 feet long by 303 feet wide and 25 feet high at its central bay. It will house kilns used in the manufacture of porcelain insulators.

All structural details will be welded in the field. This is a departure from previous practice wherein the steel members were assembled by shop welders. The welding will be supervised by engineers of the Westinghouse company.

The four Westinghouse buildings already erected by arc-welding include a five-story transformer assembly building at Sharon, Pa., and a high-voltage laboratory, chemical laboratory, and a large garage, all located in the East Pittsburgh, Pa., works of the company.

APPLIES STELLITE WITH METALLIC ARC

The Mattice Engineering Co., Inc., Philadelphia, Pa., has secured exceptionally fine results in the application of Stellite to wearing parts, with use of arc welding. Cost of application is extremely low, but two k.w. per hour being required when using the Mattice welding machine.

The Mattice Company has found Stellite to be particularly adapted to use in cement mills in the territory contiguous to Philadelphia, where it is used to advantage on such parts as dipper teeth, wearing plates on roll crushers, hammers on hammer mills, screw conveyors, gudgeons, pulverizer plows and plow arms, etc. Life of parts Stellited is increased by from four to six times.

The application of Stellite, in the experience of the Mattice Engineering Company, is as readily accomplished as is ordinary welding of bronze, steel or cast iron.

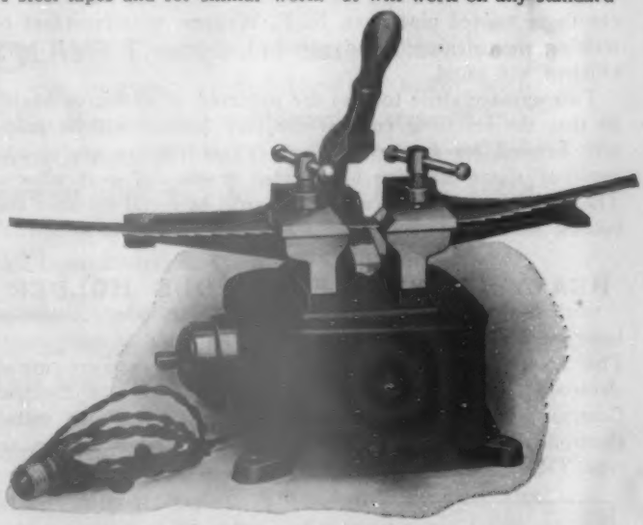
When Stelliting with the electric arc, rods should be coated and polarity should be reversed. The holding device should accommodate a $\frac{1}{8}$" rod, as the latter is more economically used than the $\frac{1}{4}$" diameter rod.

GREEN TALKS TO HEAT TREATERS

At the May meeting of the American Society for Steel Treating in Milwaukee, J. B. Green, Research Department, Chicago Steel & Wire Company, Chicago, read a paper on the subject of "Processing Welding Wire and Its Effect on the Flow of Welding Metals." The paper was accompanied by motion pictures illustrating the flow of metal in oxy-acetylene and electric arc welding.

VULCAN ELECTRIC BRAZER PLACED ON MARKET

A new electric brazer has been placed on the market by the Vulcan Electric Brazer & Welder Co., 101 East 17th Street Paterson, N. J. This machine was designed primarily for the repairing of band saw blades, but is adaptable for the brazing of of steel tapes and for similar work. It will work on any standard



Vulcan Electric Brazer.

110 or 220 light socket, A.C. current. Because of the extreme simplicity no skilled labor is required for its operation; the blade or tape is filed to a bevel large enough to make a lap joint. This lap is placed in the center of the machine and clamped. The necessary brass or silver solder and flux is added and the switch turned on and in one or two minutes the braze is completed. About 100 brazes can be completed for one kilowatt hour.

NEW UNA WELDING MACHINE OF DYNAMOTOR TYPE

A line of welders built on the dynamotor principle has been developed by the Una Welding & Bonding Co., Cleveland, Ohio. This type of construction combines both the A. C. supply and D. C. generating circuits in a single machine. Mechanically and magnetically this welder contains one simple circuit—electrically, two distinct circuits.

The welding advantages claimed are unusual arc stability, due to the fact that voltage change follows a change in resistance at electrical speed; the elimination of starting compensators and of separate exciter unit; and a high power factor.

POWER ATTACHMENT FOR FOOT-OPERATED WELDING MACHINES

A device which can be attached to any standard foot-operated spot welding machine, to convert the latter into a power machine, has been produced by The Stratford Manufacturing Co., P. O. Box 11, Stratford, Conn.

The device consists of a floor bracket carrying a short shaft, upon one end of which is a webbed flywheel of the type used on small presses. The flywheel drives the shaft through a lock-bolt clutch. On the other end of the shaft is a crock disk and pin, or a cam, according to the type of machine to

which it is to be applied. There is also a brake to stop the rotation of the shaft quickly when the clutch is disengaged.

The bracket is logged to the shop floor in a suitable position, and the pitman or cam follower is connected to the lever of the welding machine and the treadle mechanism connected to the clutch of the device. It is claimed that the attachment to any welding machine may be made in one hour.

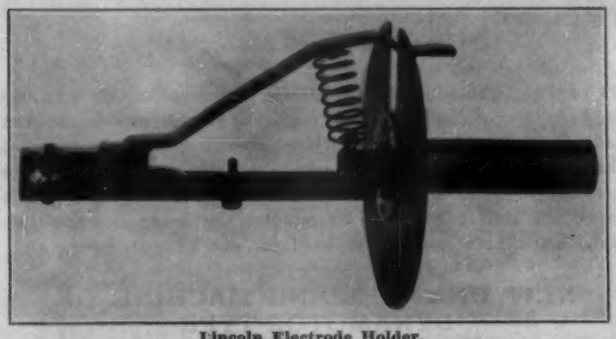
EFFICIENT CUTTING OUTFIT FOR SALVAGING PIPE LINES

The growing development toward welded joints on oil pipe lines has often made moving the lines a difficult and costly procedure. The Prairie Pipe Line Co. has welded all of its lines that have been laid in the last five years. In order that a maximum salvage may be obtained when it is necessary to cut these welded pipe lines, N. E. Wagner, superintendent of welding, has designed and patented a device which is very efficient and rapid.

Two oxy-acetylene torches are mounted at 45 degree angles so that the resulting ends of the pipe lengths will be properly beveled for future welding. These torches are slowly revolved about the pipe by a small crank and gear wheels. The only waste that occurs is the strip of metal between the cutting flames.

HEAVY CURRENT ELECTRODE HOLDER

With the coming of heavy current welding, new accessories have been necessary in the arc welding lines of equipment. The accompanying illustration shows a 600 ampere metal electrode holder just brought out by the Lincoln Electric Company of Cleveland, Ohio. This holder handles metal electrode in sizes up to ½ inch diameter and is known as type TR.



Lincoln Electrode Holder.

Many improvements are claimed for the holder, among them being—replacable copper jaws, four line contact for the electrode, all copper path for welding current, structural steel construction (maximum strength), light weight with good balance, cool insulated and ventilated handle and shield for protection of the operator's hand.

In the handling of the heavy currents which are becoming common in manual metal electrode welding practice, all of the features mentioned are of great importance. High current, high speed manual welding requires holders and accessory equipment which is designed to permit the operator to get the desired results with the maximum degree of comfort.

NEW FLUX COATED BRONZE WELDING ROD

The Lincoln Steel Company, 229 W. Illinois St., Chicago, manufacturers of "Koro," coated electrodes, have recently put on the market a new line of flux coated bronze welding rod for gas welding, to which they have given the trade name, "Koro." The base of the rod is genuine Tobin Bronze welding rod. By a special process corrugations are put in the rod at short intervals and a special flux is then forced into these corrugations. This makes it unnecessary to interrupt the flow of metal in bronze welding to dip the rod in the flux, and saves waste of flux through exposure to atmosphere or dampness, and the makers claim a considerable increase in the speed of bronze welding through the use of the new rod.

NEW FLUXES DEVELOPED FOR FOUNDRY USE AND FOR WELDING

The Basic Mineral Company, Pittsburgh, Pa., has produced a flux which they guarantee to toughen any metal 10 per cent to 25 per cent. Some are made for addition to metals in foundry work, on iron and steel and also on bronze, brass, aluminum and other non-ferrous metals, and others are made primarily for welding. An ancient secret, rediscovered in a volcano by Cassius M. Miller, these fluxes, it is claimed, will make the metal more fluid and will greatly reduce oxidation and thoroughly clean any metal in the molten state.

NEWS OF THE WELDING TRADE

Mr. E. P. Larkin has been appointed New York district manager of R. D. Thomas & Co., Philadelphia. The New York office is located at 125 Church Street.

Federal Machine & Welder Co., Warren, Ohio, is adding a new section to the company's factory. The addition covers 10,000 square feet, and is of modern glass and steel construction. When completed, it will give the plant a total manufacturing floor area of 32,000 square feet, in addition to an office building covering 5,000 square feet of floor space.

O. L. Howland, formerly of the Detroit office of the Central Steel & Wire Company, was recently appointed to the sales force of the Lincoln Steel Company, 229 W. Illinois St., Chicago. Mr. Howland has had many years experience in the welding industry as operator, salesman and service engineer, both on filler rod and apparatus, and is well known to the welding trade in the Central West.

At the regular monthly meeting of the Victorian Institute of Welding Engineers, South Melbourne, Australia, held May 26, at the workshops of the E. M. F. Electric Co., the program consisted of demonstrations of electric resistance welding and electric arc welding.

E. D. Giberson & Co., 40 Rector St., New York, have issued a four page two-color folder listing the "Excelo" line of gas and electric welding wire which they manufacture.

On June 15, S. W. Miller, Union Carbide and Carbon Research Laboratories spoke on "Fusion Welding on Boilers and Pressure Vessels" before the convention of the National Board of Boiler and Pressure Vessel Inspectors at Nashville, Tenn. His paper was followed by one on "The Application of Electric Arc Welding to Heavy Vessel Construction," read by T. M. Jasper, A. O. Smith Corporation.

A comprehensive paper on "Welding in America," by Mr. W. R. James, was read at the monthly meeting of the Victorian Institute of Welding Engineers on April 28 at Melbourne, Australia.

At the regular meeting of the American Welding Society held on May 26, Mr. E. J. Cipperly of the General Electric Company gave a talk on "Arc Welding and the Automatic Arc." Mr. Wm. Kyme of the Union Tank & Pipe Co. led a discussion on several articles appearing in recent issues of the Journal of the American Welding Society.

Strength Tests Prove:

that cast iron, properly welded with Tobin Bronze, never fails at the weld

PERFECT samples of cast iron bars were cut in two, welded together again with Tobin Bronze, and subjected to straight pull strength tests. All failed in the cast iron—there were no failures in the bronze. In fact, Tobin Bronze would have resisted failure if the stress had been twice as great.

In addition to its strength, Tobin Bronze has the advantage of flowing freely at 1650°F. This low welding temperature usually eliminates preheating and dismantling, and minimizes distortion of the casting.

Many manufacturers who have proved the value of Tobin Bronze welding for repairs are now using it to save time and money in manufacturing operations.

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONNECTICUT
Offices and Agencies in Principal Cities
Canadian Mill: ANACONDA AMERICAN BRASS LIMITED
New Toronto, Ontario

TOBIN BRONZE

REGISTERED U.S. PATENT OFFICE

WELDING RODS

EXCLUSIVELY AN ANACONDA PRODUCT

You Should Exhibit

WELDING *and* CUTTING EXPOSITION

Auspices American Welding Society

In Co-operation With

National Steel *and* Machine Tool Exposition

CONVENTION HALL

DETROIT

September 19, 20, 21, 22, 23, 1927

Only a few spaces unreserved—The largest and best welding exposition ever held. The location—Detroit—is your ideal market.

80,000 in attendance.

The following firms have madé reservation:

LIST OF FIRMS:

Acme Electric Welder Co.
Air Reduction Sales Co.
Allan Mfg. & Welding Co.
American Brass Co.
American Electric Fusion Corp.
Carbic Mfg. Co.
Central Steel & Wire Co.
Chicago Steel & Wire Co.
Electric Arc Cutting & Welding Co.
Federal Machine & Welder Co.
General Electric Co.
Gibb Welding Machine Co.
Keith-Dunham Co.
Krembs & Co.
Linde Air Products Co.
Metal & Thermit Corp.
Milburn Co., Alexander
Northwestern Mfg. Co.
Page Steel & Wire Co.
Rail Joint Co.
Roebling's Sons Co., John A.
Shawinigan Products Co.
Thomson Electric Welding Co.
Torchweld Equipment Co.
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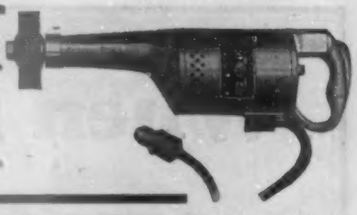
For complete information, floor plans and rates, write

American Society *for* Steel Treating

4600 Prospect Avenue :: Cleveland, Ohio

Another chance to cut cost—Use a Wodack



Labor is the biggest factor in welding costs. You can reduce the labor charge on many jobs with the handy WODACK Portable Electric Grinder. Its convenience makes any grinding job easy. Use it before and after welding. Let us tell you what other welders say of the WODACK Grinder.

Wodack Electric Tool Corporation

4627-29 W. HURON ST. CHICAGO, ILL.

The Goodman Electric Machinery Co. of Newark, N. J., who are specialists in rebuilt welding machinery, are now furnishing new machines of various standard makes in addition to their regular line of rebuilt welders. As part of the service that this company offers, the customer may trade in his old machine as part payment on a new one.

The Big Three Welding & Equipment Company of Fort Worth and Houston, Texas, who are the Texas and Oklahoma distributor for "Stable-Arc" Welders, manufactured by The Lincoln Electric Company, Cleveland, Ohio, announce the opening of their third warehouse branch at No. 1 North Frankfort St., Tulsa, Oklahoma. The rapid development of this company is an indication of the growing importance of welding in the Southwest. Stocks of Lincoln "Stable-Arc" welders and and service parts are carried at all three branches. A great deal of the success of the Big Three Welding & Equipment Company has been due to the competent welding engineering service they are able to render, each branch being managed by a competent welding engineer thoroughly conversant with both arc welding and gas welding.

The Lincoln Electric Company, of Cleveland, announce the appointment of the Wade Engineering Company, 1855 Industrial Street, Los Angeles, California, as distributor of Lincoln products in California.

This company maintains a branch at 69 Webster Street, Oakland, California, both main office and branch carrying stock of Lincoln "Linc-Weld" motors and "Stable-Arc" welders, as well as service parts.

The Los Angeles branch is in charge of Mr. Henry N. Wade, who is also president of the company. Mr. Wade is an experienced electrical engineer and a graduate of Cornell University. For seven years he was in charge of alternating current development with the Cutler Hammer Manufacturing Company, and for two years was sales manager of the Keystone Iron Works, Los Angeles. For the past three years he has been engaged in engineering and consulting work with various oil companies.

The Oakland branch is under the direction of Mr. H. T. Lintott, who is also an experienced electrical engineer and a graduate of the University of Nevada. For the past ten years Mr. Lintott has been electrical superintendent with the Pacific Coast Steel Company of San Francisco, and is widely known in the Bay district.

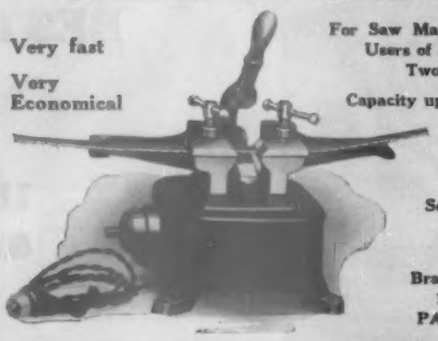
The Wade Engineering Company is handling "Linc-Weld" motors over the entire state of California and "Stable-Arc" welders in the northern and central parts of the state. The A. H. Peir Company will continue to handle "Stable-Arc" welders in southern California as in the past under the active management of Mr. C. J. Nyquist.

"Vulcan" Electric Brazer

For Band Saw Blades and similar flat work

Very fast

Very Economical



For Saw Manufacturers and Users of Band Saws. Two Sizes.

Capacity up to 5 inches.

Send for Circular.

Vulcan Electric Brazer & Welder Co.
101 E. 17th St.
PATERSON, N. J.

BUTT Rebuilt Welders SPOT

Guaranteed to be in Perfect Condition

One Thomson 40-A Butt Welder.
One Thomson 9-A Butt Welder.
One Thomson 10-A Butt Welder.
One Thomson 5-A Butt Welder.
One Thomson 3-A Butt Welder.
One Thomson 2-A Automatic Butt Welder.
One Toledo 3 Butt Welder.
One Toledo 137 Spot Welder.

Many Others—WRITE.

TAYLOR-HALL WELDING CORP.
7 May St. Worcester, Mass.

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

Wanted—The address of every gas and electric welder in the United States. Send them to Knight Brothers, 113 S. Oakley St., Chicago, Ill.

For Sale—Service rights on W. K. and W. C. Prest-O-Lite Cylinders, large or small quantities. Alfred E. Corp., 40 Mathewson St., Providence, R. I.

Men Wanted—We wish to get in touch with several electric welders who have had experience in structural steel welding and are good on overhead work. Only experienced men need apply. Slaymaker Electric Welding Co., 686 W. Grand Blvd., Detroit, Mich.

Position Wanted—Electric and acetylene welder 29 years old. Single. Experienced on locomotive boilers, structural steel, tank and job work. Willing to go anywhere in U. S. or abroad. Address Gus Likas, Box 464, Oelwein, Iowa.

Position Wanted—Electric Welder, 34 years old. Married. 13 years experience. Willing to travel. Wants steady work, with overtime if possible. Address 118, care The Welding Engineer.

"STANDARD" Welding Wire GAS AND ELECTRIC

for sound permanent welds : : lower costs

Our costs are considerably under those of large industrial centers; ours is a one-profit wire sold direct to user from our own mills exclusively devoted to making of welding wire from raw material to finished product—hence our extremely low prices for wire that is definitely superior. Adopted exclusively by many large users.

Prices on request.

A grade for each type of work—send for samples. Standard Steel & Wire Co., Greensburg, Pa. (Mills at Bolivar, Pa.)

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BEST for All Industrial Purposes

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IN THE RED DRUM SAVES YOU MONEY

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Warehouses in All the Principal Cities

National Carbide Sales Corporation, 342 Madison Ave., N. Y.

This Machine Is Made Especially for Butt Welding High Pressure Pipe Coils

ENGINEERS experienced in the extreme conditions encountered in gasoline production assisted Federal engineers in designing this machine for making still coils. Now the expensive and hazardous joints of yesterday are eliminated and these coils are made by butt welding—simpler, safer, and cheaper.

With this No. 90 machine a complete coil is welded in 50 minutes, including all handling time. This is over eight times faster than former production when arc welding was used, and **every weld is 100%** in strength. Each coil is tested at 7000 lbs. pressure after completion.

We make butt welders that will handle coils made of six-inch extra heavy tubing, by the same method. They speed up production and make a safer and stronger coil.

Type No. 90 Pipe Butt Welder
Other types for every variety of tube from small rounds to thick walled locomotive boiler tubes. Send for our bulletins on pipe welding.

Federal
Machine & Welder Co.
Warren, Ohio, U. S. A.

Offices in all large cities and if not listed in your telephone directory, write us direct.

We are pioneers in the production of all types of electric spot, butt and seam welders.

True Arc Stability
is obtained in these windings

Field Ring of Hansen Arc Welder
Showing poles, field windings, and stabilizing coils

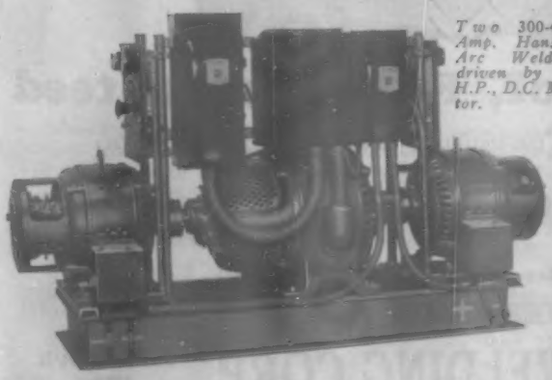
Notice that since the stabilizing of the arc is accomplished entirely by the generator windings there is no external stabilizing device on the

HANSEN
ARC WELDER

This construction is an exclusive feature of Hansen Welders. It reduces the weight of the machine and saves you the cost of an extra item. Then, in service, it saves the maintenance cost of an external stabilizer, and waste of electrical energy.

Although light and compact, this welder is rugged and wear-proof. And its rated capacity is not a maximum, but a continuous-operation capacity. These features make the HANSEN ideal for production arc welding, enabling the operator to do the finest work with minimum attention to the machine.

NORTHWESTERN MFG. CO.
Clinton and Madison Sts. Milwaukee, Wis.



Two 300-400 Amp. Hansen Arc Welders driven by 40 H.P., D.C. Motor.

WISSCO GRADE NO. 2 SPECIAL. PROCESSED ELECTRODES
Developed for particular consumers; i. e. Railroads, Shipyards, Boiler Makers, etc., for use on general repair work.

NO RIVETS--NO FITTINGS ONLY WISSCO WELDS ON THIS LARGE TANK AND PIPE LINE

An ice plant with a capacity of 500 tons is being constructed for the Canadian Government at Toronto, by the Carbondale Absorption Machine Co. Ltd., of Montreal.

The ice tank, 70′ by 32′ by 5.5′, of ¼″ plate, has just been completed. No rivets were used and no standard tees were employed as fittings; the entire job, including all cross lines from the main line, was electrically welded by the Thompson Welding Co., Limited, of Toronto, with Wissco No. 2 Special Processed Electrodes. A pressure of 180 pounds is required in the ammonia line, and the welds were tested to stand a pressure of 300 pounds.

Each grade of Wissco Welding Wire is composed of special analysis, especially processed wire produced for a certain type of welding.

All Wissco Welding Wire is tested for chemical, physical and welding properties before being passed. Uniformity and proved welding ability are thereby insured.

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Please send me your booklet "Wissco Welding Wire."

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Steel Sales Welding Rods

A Welding Rod for Every Job

Gas NORWELD Welding

Norweld, one of our leading rods, is a copper coated, low carbon soft wire for acetylene welding; uniform in quality; recommended for welding of wrought iron, steel, tanks, boiler plate, sheets, angles, flues, etc., where higher tensile strength is required.

Other rods carried in our Chicago stock for immediate shipment are:

Wilson Color-tipt	E†	Elecweld special	E
Norweld Special	A*	Elecweld	E
Norweld	A	Steelweld	E
Castweld	A	Vanadweld	A&E
Bronzeweld	A	Hicarweld	A&E
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*Acetylene †Electric

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Waters Electric Arc Welder

A Dependable MACHINE

Fool-proof, Trouble-proof, Fully guaranteed

The Waters line possesses many exclusive and particularly advantageous features, information concerning which will be furnished upon request.

For all welding requirements, both light and heavy, in all industries. Insures sound, permanent welds.

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Burdett Oxygen Co.....597 Beaufait Ave., Detroit, Mich.
Burdett Oxygen Co.....23rd and Jones St., Ft. Worth, Tex.
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Address correspondence and orders to nearest plant listed above. Shipment will be made from plants or from warehouses in 15 cities.

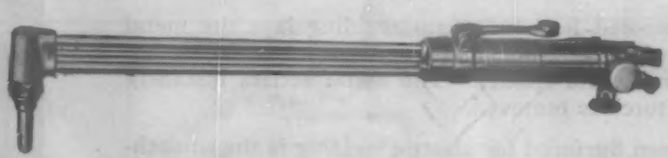
Burdett Oxygen salesmen are backed up by this manufacturing principle—that pure oxygen is what your shop needs for welding and cutting. Burdett Oxygen is always made under exacting inspection control.

USE BURDETT OXYGEN—It's the best

The Result is the Same

K-G CUTTING TORCHES Save Gas

Sometimes K-G cutting torches seem to use less oxygen than other makes, when as a matter of fact the saving is largely accounted for by the fact that K-G Torches do not leak. The commonest source of trouble with most cutting torches is leakage around the excess oxygen trigger valve. The trigger valve in the K-G is purposely made simple and accurate to prevent this costly leakage loss.



K-G Style "M" Cutting Torch

Supplied with four interchangeable tips. Tips come in eight standard sizes, 1 to 4 having either three or five preheating holes, as desired, and 5 to 8 having five preheating holes. Tips for use with any cutting gas carried in stock.

Special tips can be furnished for every cutting requirement.

Length of standard torch, 28 inches; weight, 2 lbs., 9 oz. Torch can be made any length desired.

Scientific simplicity of construction in K-G Torches reduces manufacturing operations and thus allows the use of better materials without increase in price. For example, heads and tubes are made of monel metal, which is non-corrosive and harder and more durable than any brass or bronze composition. In continuous service users find K-G cutting equipment to take the lead for operating efficiency and durability.

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Phone Chickering 0996-7-8

K-G

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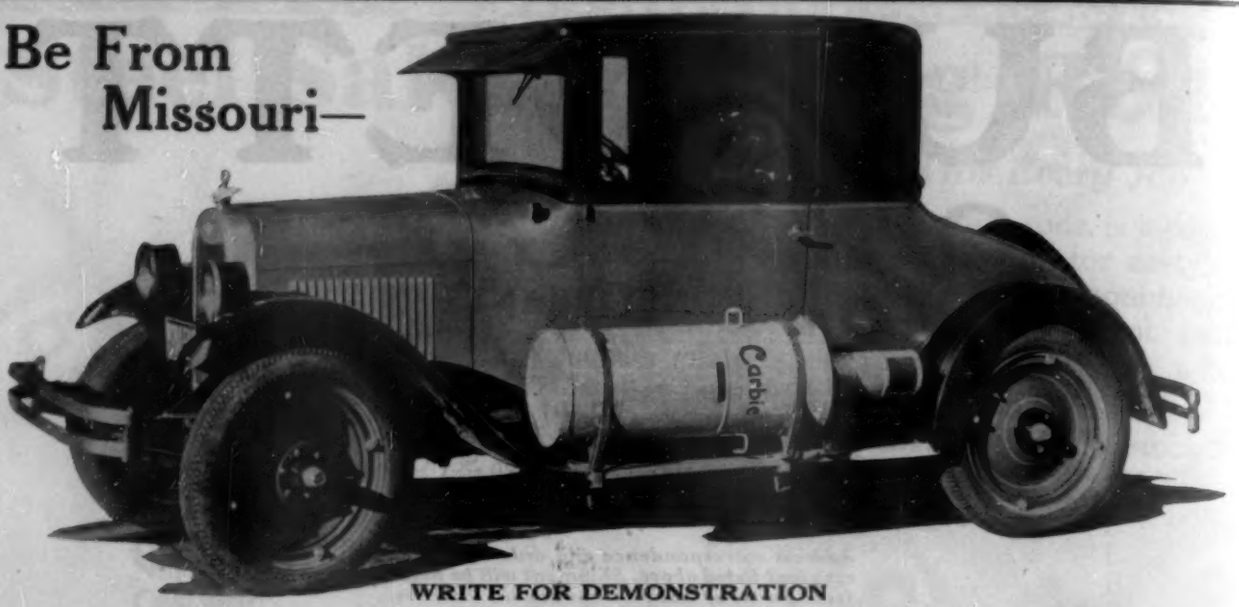

WRITE FOR DEMONSTRATION
OF THE
CARBIC PORTABLE ACETYLENE GENERATOR
FOR WELDING AND CUTTING

Safe, Simple, Efficient, Portable, Economical—All of These in the Carbic System
THERE IS A SALESMAN NEARBY, READY TO SHOW YOU THESE FEATURES

CARBIC MANUFACTURING COMPANY

DULUTH, MINN.
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NEW YORK CITY
141 CENTRE ST.

—STOCKS IN OVER 75 PRINCIPAL CITIES—

Weldite

Welding Rod

Weldite G—No. 6 Coppered Finish for gas welding lays the metal down quietly, free from boiling, free from surface scum and floating white specks. The metal settles instantly when the torch is removed.

Weldite E—No. 18 Green Surfaced for electric welding is the smoothest running electrode ever offered users of welding. Sold at the price of bare electrodes.

Products of the Research Department

CHICAGO STEEL & WIRE Co

103rd Street *and* Torrence Avenue CHICAGO

THEY GOT THE FACTS

and prevented a 30% increase in their Oxygen and Acetylene costs

A TORCHWELD distributor learned that a new torch was being offered in his territory on the basis of its being more economical than Torchweld. His customers wanted the facts, so a test was made in a customer's plant. Then our distributor reported as follows:

> "We have just completed a test in which Torchweld used nearly thirty percent less Oxygen and Acetylene than the other torch.
>
> "This company has always used Torchweld and the results of this test will continue its use."

Buyers who know the facts specify Torchweld Torches because they make gas welding cost less. They use less Oxygen and Acetylene, they take less time for a job, and they need less repair expense than any other torch.

Figure your welding cost per welder for a year, and itemize it. Where would it profit you most to save 30%? Not in the apparatus cost because that is the **smallest** item. Torchweld saves you money on the big items of Oxygen, Acetylene and operating time. That's one reason why Torchweld Torches are standard equipment with manufacturers who figure costs the right way.

TORCHWELD EQUIPMENT COMPANY

226 N. Carpenter St. CHICAGO

GET THE FACTS

The reasons for Torchweld economies are explained and illustrated in our new catalog. Send for your copy.

STOODITE—THE SUPER HARD FACING METAL

Stoodite is the hardest, toughest, and has the greatest resistance to abrasion of any metal

Hardness must not be confused with Abrasive Resistance, a metal that is hard does not mean that it will resist abrasion. Stoodite has the combination of these qualities: extreme hardness and the greatest amount of resistance to abrasion. These qualities make Stoodite the most efficient metal for hard facing oil well drilling tools, hog anvil knives, aeroplane skid shoes, steam shovel teeth, farm implements and wherever an extremely hard and abrasion resisting metal is required.

Write for further information

STOODY COMPANY

Whittier WHITTIER, CALIFORNIA Oakland

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ALMANC

METALLIC

ELECTRODE HOLDER

Most Simple—Most Efficient—Metallic Electrode Holder Yet Developed.

There are no springs to lose tension for the grip is positive through both jaws. Careful construction has reduced heating to a minimum, while the operator is at the same time fully protected from shocks. It is simple to quickly insert and release the electrodes, which can be used with very small amount of waste. Its construction permits the removal or replacement of the holder cable with only the aid of a screw driver—it is not necessary to use soldering. All of these exclusive features make the Almanc Metallic Electrode Holder a wise buy. *Distributors Wanted*

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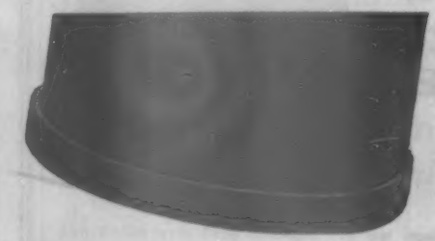

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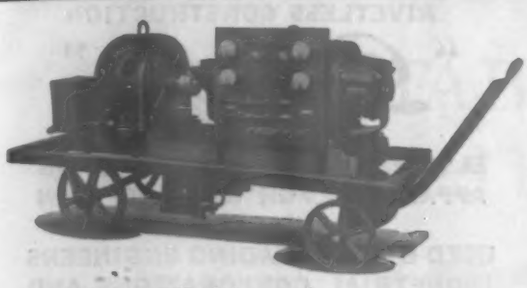

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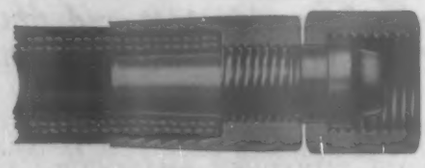

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Fig. 3—Showing punch press projections which locate spot welds

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Fig. 2—Dark spots show 6 welds made simultaneously

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